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JANUARY, 1947.

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THE AUSTRALIAN AND NEW ZEALAND JOURNAL OF SURGERY

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PENICILLIN IN THE TREATMENT OF INFECTIONS IN THE NASAL PASSAGES AND SINUSES.[1]

By RICHARD E. DUNN,
Sydney.

THE treatment of infection in the nose and accessory sinuses is at the best of times difficult and controversial. The chronic infectious and allergic manifestations in this region are so intermingled and correlated that only conscientious investigation of each case can offer any successful relief for patients.

To quote but one example: A patient received penicillin treatment for attacks of pansinusitis at monthly intervals during a period of six months. The organism on every occasion was *Staphylococcus aureus,* which is sensitive to penicillin. Finally, allergic tests were carried out, and the patient gave a marked reaction to kapok. The offending substance was removed from the patient's daily life, and, for the following six months, whilst contact was maintained with the department, he was free from signs and symptoms of sinusitis.

Hence, in the anxious desire to eliminate a penicillin-sensitive organism, it is possible to overlook the primary factor causing the malady. Similarly, penicillin treatment cannot replace the necessity for surgical removal of abnormalities causing stasis in the nasal passages and sinuses.

Here is the account of an attempt to treat infective conditions of the nose and accessory sinuses with penicillin. The selection of cases chosen depended almost entirely on the presence of a penicillin-sensitive organism in the antral washes or nasal discharge, whilst the methods of administration were determined by the most efficacious means of delivering penicillin to the regions involved in the nasal passages and sinuses.

METHODS OF ADMINISTRATION OF PENICILLIN.

Four methods are described here for the administration of penicillin to patients suffering from infection of the nasal passages and sinuses, namely:

1. Local application: (*a*) displacement (Proetz), (*b*) drops, (*c*) proof puncture and instillation, (*d*) continuous irrigations.

2. Intramuscular injection.

3. Local application of penicillin combined with oral administration of sulphamerazine.

4. Both intramuscular and local application of penicillin.

[1] Accepted for publication on August 21, 1946.

Prior to treatment, patients were submitted to X-ray examination and proof puncture of the antrum, and had a culture grown from the nasal discharge or the antrum wash.

A combination of the above methods was used, according to the requirements of the case. For example, in acute sinusitis, an immediate and certain access of the drug to the affected sinuses is required. Because of the local œdema, the only sure way is via the blood stream, hence the intramuscular use of penicillin or the administration of sulphamerazine by mouth. In this way, the drug permeates the tissues ahead of the advancing infection, and not following it, as would be the case in local applications. Subacute antritis lends itself to instillation of penicillin by proof puncture or by continuous drip or both. Subacute frontal, ethmoid and sphenoid sinusitis are approachable by Proetz's displacement method, combined with drops.

FIGURE I. Patient's chin and external auditory meatus in the same vertical line. Compressed bag in one nostril and a finger blocking the other.

Local Application.

Local application was the method adopted in the majority of the cases. It offers a direct and high concentration of the drug in the affected sinuses. Under this heading are four ways of applying penicillin locally to the affected areas in the nasal pasages and sinuses, namely: (*a*) by displacement of air from the sinuses by penicillin, with the use of Proetz's method; (*b*) by the use of nasal drops; (*c*) by proof puncture of the antra and instillation of penicillin; (*d*) by continuous irrigation of antra with penicillin.

Displacement Method (Proetz).—When the displacement method is used the patient lies on the back with the head hyperextended, so that the chin and external auditory meatus are in the same vertical line (see Figure I).

A few drops of ephedrine (1%) in normal saline solution are applied to each nostril to reduce mucosal congestion. The patient is instructed to sniff, and, after a period of half a minute, one drachm of penicillin is placed in each side of the nose.

Displacement of air in the sinuses by penicillin is achieved by applying a compressed Politzer bag to one nostril, at the same time occluding the other. The patient places the tongue in the position of saying "K". Compression on the Politzer bag is released for a few moments (see Figure I).

It will be noted that the post-nasal space is closed and "suction" is applied to the nasal vestibule. This reduces pressure in the nose. The air pressure in the sinuses is now greater than that in the nose; consequently the air passes from the sinuses to the nose. The Politzer bag is now removed from the nostril and the patient regains his breath by breathing through the mouth.

At the present stage it will be noted that the post-nasal space and the vestibule are again open to the atmosphere. There is no longer reduced pressure in the nose, and the air pressure in the sinuses is less than that of

the nose. Since the ostea are below the fluid level of the penicillin in the nose, this drug is drawn into the sinuses during the restoration of the pressure equilibrium between the nose and the sinuses (see Figure II). This process is repeated several times to each nostril and a further drachm of penicillin is added to each side.

The displacement method was used twice daily and was supplemented by the nasal instillation of penicillin drops every two hours. Penicillin concentrations used were: 250 to 2,500 units per cubic centimetre, but 500 units per cubic centimetre were quite adequate.

Figure III illustrates the amount of filling achieved, the limitations and fallacies of Proetz's displacement method in a case of sinusitis. A moderate filling was obtained by the lipiodol in all the sinuses except the left antrum and both frontal sinuses.

Here is displayed one of the fallacies of this method. Either the ostium was blocked by congestion of the mucosa or the application of suction drew mucopus into and blocked the ostium, thus preventing removal of air from that sinus and resultant replacement by lipiodol.

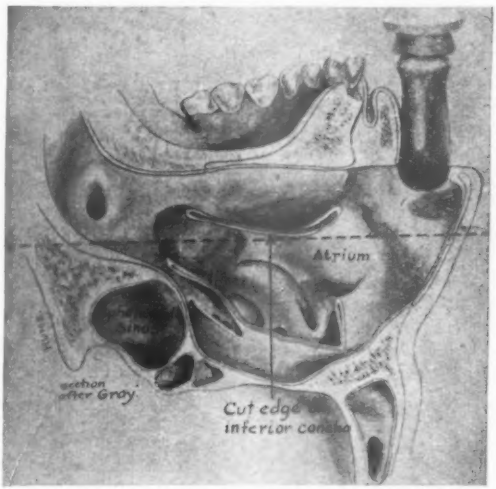

FIGURE II. Turbinates removed to display ostea beneath the level of penicillin, which is indicated by the dotted line.

This is obviously likely to occur in any of the other sinuses. However, in the presence of mucosal congestion it is hoped that with continued treatment the congestion will subside and that eventually the ostia will open and allow the introduction of penicillin into the affected sinuses. These remarks would apply more particularly to the frontal sinus, with its long fronto-nasal duct.

On contemplating the picture of a sinus filling with lipiodol, and considering the fact that penicillin is more fluid than lipiodol, it is reasonable to expect an even greater filling in the case of penicillin.

Nasal Drops.—In the use of nasal drops the patient assumes a similar position to that used in Proetz's displacement method (Figure I). One drachm of penicillin is inserted into each nostril. The patient retains the posture for two minutes. The procedure is repeated every two to four hours. Whilst the penicillin concentrations on this occasion were 500 to 1,000 units per cubic centimetre, 500 units per cubic centimetre were quite adequate.

Proof Puncture and Instillation.—With proof puncture and instillation penicillin is introduced directly into the antrum after it has been washed with saline solution. Three to four cubic centimetres of 500 to 5,000 units of penicillin are introduced through the cannula. This is done once or twice a day for from five to ten days.

Continuous Penicillin Irrigation.—The apparatus for continuous penicillin irrigation is illustrated in Figure IV, whilst the method entails the antrum being proof punctured and washed. Then a second cannula is introduced into the antrum, an inlet and an outlet for penicillin being thus provided.

The sterile apparatus is then connected as in Figure IV, so that the cannula providing the inlet is placed less deeply in the antrum than the other. This prevents the penicillin from running straight from one cannula and out by the second without irrigating the antrum.

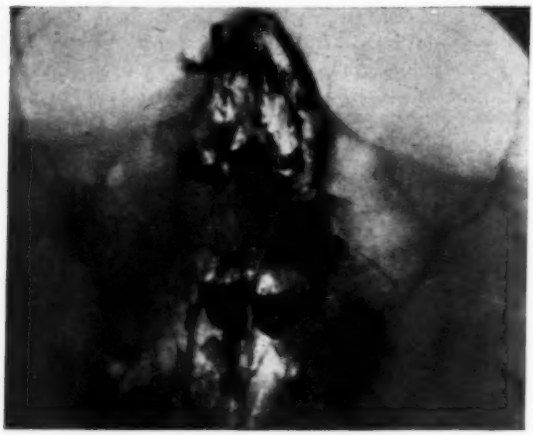

FIGURE IIIA. Displacement of air by lipiodol in a case of sinusitis. (Postero-anterior view.)

The maintenance of the apparatus was carried on by the nursing staff. Obstructions occurred occasionally and it was necessary to disconnect the tubing from the cannulæ and to irrigate with a Higginson's syringe to remove mucus from the outlet. A slow drip was continued for twelve hours and repeated twelve hours later for a similar period. Discomfort, experienced as cocainization ceased to be effective, was relieved by morphine and aspirin when necessary.

Intramuscular Injection.

Intramuscular injection has the advantage of carrying the drug to the affected sinuses via the blood stream, but only in limited concentrations. This can be appreciated from the statements of Rammelkamp and Keefer,[1] who wrote in May, 1943:

(*a*) After intravenous injection of 20,000 units the blood level rose to 0·625, and 140 minutes later no penicillin was found. After intramuscular injection there was a slower rise and the blood level was not so high. This was followed by a slower fall, the peak in the blood level occurring 30 to 45 minutes after the injection.

(*b*) No penicillin was found in the saliva or tears after intramuscular injection.

Hence one of the disadvantages of this method is that it necessitates large quantities of the drug being used to maintain only a relatively low concentration in the sinus area.

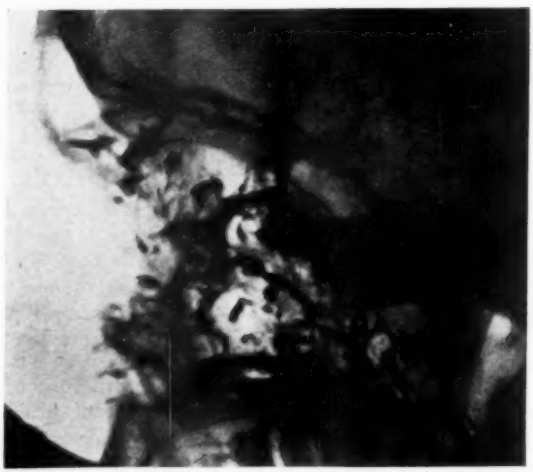

FIGURE IIIB. Displacement of air by lipiodol in a case of sinusitis. (Lateral view.)

A further handicap to this method is the necessity for a nurse trained in asepsis to administer the drug by intramuscular injection throughout the day and night. It is worthy of note that the local discomfort experienced after injection varies considerably with the person administering the injection.

The method adopted at this time was an intramuscular injection of 4·0 cubic centimetres of a solution of 5,000 units of penicillin per cubic centimetre every three hours for seven to eight days. The site of injection is varied to minimize local discomfort.

Local Application of Penicillin Combined with Oral Administration of Sulphamerazine.

The procedure adopted in the case of a patient with clinical evidence of acute sinusitis was as follows. Firstly, an X-ray picture was taken of the sinuses; secondly, a culture was grown from the nasal discharge or antrum wash; and thirdly, oral administration of sulphamerazine was commenced without delay. The sulphamerazine course entailed the administration of 28·0 grammes over a period of five days and a maintenance dose of 1·0 gramme daily, if necessary.

Efforts to combat toxicity necessitated the keeping of a fluid chart and ensuring that two to four pints of urine were passed every day. Also the urine was kept alkaline to litmus, and blood counts were taken after the fifth day.

FIGURE IV. Showing (*a*) theatre cap, (*b*) one flask with drip indicator, (*c*) two small rubber tubes, (*d*) drip regulator, (*e*) two cannulæ (proof puncture), (*f*) small bottle.

Combined Intramuscular Injection and Local Application of Penicillin.

The combination of intramuscular and local application of penicillin offers the maximum concentration of the drug in the sinus area.

BACTERIOLOGICAL INVESTIGATION.

The significance of cultures grown from nasal and antral washes is difficult to

TABLE I.

Microorganism.	Condition of Patients.	Number of Cases.	Remarks on Cultures.
Staphylococcus aureus	Relieved.	18	8 pure cultures, 10 mixed growths.
	Improved.	7	4 pure cultures, 3 mixed growths.
	Unrelieved.	4	4 mixed cultures.
β - hæmolytic streptococcus	Relieved.	6	2 pure cultures, 4 mixed growths.
	Improved.	5	2 pure cultures, 3 mixed growths.
	Unrelieved.	2	
Green-zoned streptococcus	Relieved.	16	4 pure cultures, 12 mixed growths.
	Improved.	5	2 pure cultures, 3 mixed growths.
	Unrelieved.	10	4 pure cultures, 6 mixed growths.
Pneumococcus	Relieved.	4	3 pure cultures, 1 mixed growth.
	Improved.	5	3 pure cultures, 2 mixed growths.
	Unrelieved.	4	1 pure culture, 3 mixed growths.
No growth	Relieved.	5	
	Improved.	1	
	Unrelieved.	1	
Pyocyaneus	—	7	

estimate. There were several cases in which a penicillin-susceptible organism was produced and in which, contrary to expectation, no relief was obtained; there were also cases in which a mixed growth of penicillin-susceptible and non-susceptible organisms was obtained and in which relief was claimed. However, in the former group, unfortunately facilities were not available to test the penicillin resistance of the particular strain of organism.

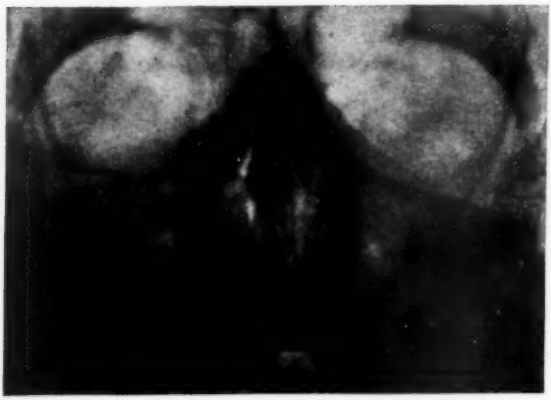

FIGURE VA. Opacity of the right and left antra.

In several cases after prolonged treatment with penicillin a change of growth occurred in the antral washes from a penicillin-susceptible organism to *Bacillus pyocyaneus*, which is encouraged by the presence of penicillin. A dilute solution of merthiosal was added to the penicillin, and it appeared to prevent the incidence of *Bacillus pyocyaneus* without reducing the activity of penicillin. (See Table I.)

SELECTED CASE REPORTS.

Case A.

The patient complained of having had a heavy feeling behind the nose on and off for five years, together with intermittent nasal discharge over the same period, culminating in an attack which continued practically without cessation for three months. He gave a previous history of asthma for five years.

On examination mucopus was present in the left side of the naso-pharynx and on the right and left sides of the nose. X-ray examination of the sinuses was carried out on August 19, 1944, and the report indicated gross mucosal thickening in both antra (see Figure VA), with irregular loss of translucency in the ethmoids and frontals. A double antrum proof puncture followed on August 22, 1944. This produced on the right side a moderate blob of mucopus, whilst the left side yielded a few shreds. This was sent for cultural examination on the same date, and returned a sparse growth of pneumococcus type III.

FIGURE VB. Improved translucency in both antra after penicillin treatment for three days by Proetz's displacement method.

Treatment.—Penicillin was administered by the displacement method and was commenced on August 26, 1944; it was continued twice daily for four days. The strength of the penicillin used was 500 units per cubic centimetre.

On the third day eczema developed on the nose, upper lip and face. The patient refused to continue the treatment, but submitted to a specimen being taken for cultivation and a further double antrum proof puncture being performed. These were both done on August 31, 1944. The proof puncture was clear on both sides, whilst the culture from the nose contained a scanty growth of *Staphylococcus albus*.

The sinuses were examined by X rays on September 1, 1944, and the report indicated that the frontals and ethmoids were clear, although slight mucosal thickening remained in the antra (see Figure VB).

Case B.

The patient complained of sore throat and nasal discharge for three days.

On examination mucopus was seen in the naso-pharynx and the nose on the right and left sides, whilst the pharynx was inflamed. X-ray examination of the sinuses on July 16, 1944, revealed slight mucosal thickening in the anterior sinuses (see Figure VIA), whilst the culture grown from the nasal discharge on the same date consisted of a pure growth of β-hæmolytic streptococci. However, the culture grown on July 23, 1944, seven days later, when no response was obtained to the sulphamerazine course, contained a moderate growth of hæmolytic streptococci and a few colonies of hæmolytic *Staphylococcus aureus*.

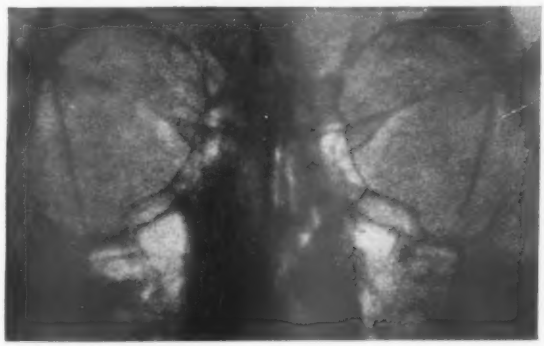

FIGURE VIA. Loss of translucency in right and left ethmoids.

The double antrum proof puncture performed on July 20, 1944, produced a few shreds from the right side and from the left only a very small blob of mucopus.

Treatment.—A low course of sulphamerazine was commenced on July 15, 1944, when the patient first attended the clinic. No marked improvement was noted at the end of a week, so a further proof puncture was done on July 23, 1944. This produced on the right side a slightly cloudy return, and on the left side a small blob of mucopus. On July 27, 1944, the right and left antra were again washed, and on this occasion the washing produced a moderate-sized blob of mucopus. Penicillin nasal drops were then administered every two hours for ten days. Another double antrum proof puncture was done on August 2, 1944, and this produced a clear return on the right side and only a small blob of mucopus on the left.

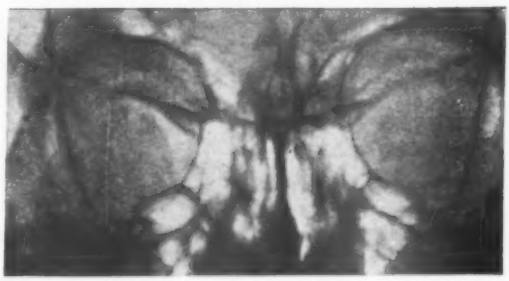

FIGURE VIB. Improved translucency in both ethmoids following application of penicillin nasal drops and a low course of sulphamerazine.

X-ray examination of the sinuses showed an improved translucency (see Figure VIB) and the final double antrum proof puncture on August 10, 1944, was clear.

Case C.

The patient complained of pain over the right cheek and of offensive discharge into the mouth for one week. The symptoms had recurred on and off for the past six months.

On examination the patient had tenderness over the right cheek, mucopus in the right side of his nose, and a small sinus in his right upper jaw, where a tooth had been removed. X-ray examination on January 30, 1945, revealed an opaque right maxillary antrum and a retained tooth root in the right upper jaw. (See Figure VIIA and insert.) The right antral proof puncture produced a large quantity of offensive pus. This grew a culture of green-zoned streptococcus and hæmophilus bacillus.

Treatment.—A full course of sulphamerazine was commenced on January 29, 1945, together with daily antrum proof punctures and saline solution washes, followed by penicillin instillation. The returns from the proof punctures showed daily improvement

FIGURE VIIA. Opacity of right antrum. Inset: Retained tooth root projecting into antrum.

for five days. (See Figure VIIB.) The patient was then seen by the dentist, and the report told how the tooth root had been removed from the right upper jaw and a large quantity of putrid pus released by the extraction. The same day the antrum was again proof punctured and the return, which a few days before had been clear, was once again cloudy and offensive.

Continuous penicillin irrigation was commenced on February 24, 1945. This was continued for twelve hours, a strength of 1,000 units per cubic centimetre being used. A proof puncture on the following day produced a return that was still cloudy and offensive. The continuous penicillin irrigation was commenced again for another twelve hours. The next day the return from proof puncture was cloudy with a few shreds, and penicillin was instilled. However, the following day (February 27, 1945) the proof puncture returned only a few shreds. Penicillin was unobtainable for the next four days, so a solution of "Solutox" was instilled after each daily proof puncture and wash. By March 3, 1945, the proof puncture return was clear, and on March 7, 1945, the patient was discharged to a convalescent depot.

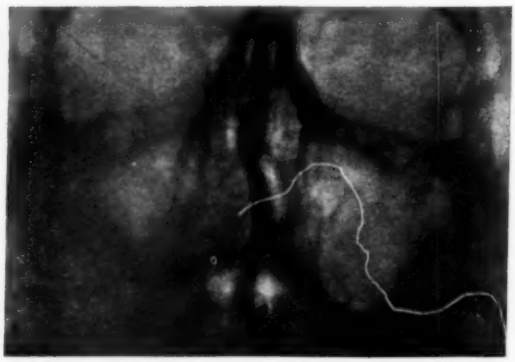

FIGURE VIIB. Slightly improved translucency in right antrum after first treatment with penicillin by instillation.

On March 18, 1945, he returned with a relapse, and the proof puncture produced a return which contained a few shreds of mucopus and was cloudy and offensive. Continuous penicillin irrigation was again commenced, this time only 250 units per cubic centimetre being used for twelve hours. The following day the return from the proof puncture contained a moderate blob of mucopus. Continuous penicillin irrigation was again continued for another twelve hours. The proof puncture on the next day was still a large blob of mucopus. For the following six days "Solutox" was instilled daily, and by March 26, 1945, the return was clear.

FIGURE VIIC. Markedly improved translucency in right antrum following two further courses of penicillin by continuous drip. (See Figure IV.)

The patient was reviewed after two weeks' convalescence.

Being free from symptoms, and X-ray examination showing improved translucency in the right antrum (Figure VIIc), he was then discharged from hospital.

Case D.

The patient had a cold for seven days and experienced pain over the right cheek for three days. X-ray changes were evident in the right antrum and right ethmoid on September 21, 1944. (See Figure VIIIA.) A cloudy return was obtained from a right antrum proof puncture, which grew a culture of β-hæmolytic streptococcus.

FIGURE VIIIA. Opacity of right antrum.

Treatment.—The right antrum was proof punctured on September 26, 1944, and the return from the saline wash was cloudy. Continuous penicillin irrigation was also commenced on that day; 2,500 units per cubic centimetre, with "Merthiolate", were used for twelve hours. The next day (September 27, 1944) the proof puncture returned a moderate blob of mucopus, and the continuous penicillin irrigation was again continued for another twelve hours. On the following day the result of the proof puncture was slightly cloudy and contained a moderate blob of mucopus. The instillation of penicillin nasal drops every two hours was started. Again, on September 29, 1944, the result of proof puncture was not much improved, so penicillin was instilled. On September 30, 1944, the proof puncture returned a moderate blob of mucopus. However, penicillin treatment was discontinued and the patient was allowed to convalesce for one week.

FIGURE VIIIB. Improved translucency in the right antrum following penicillin treatment by continuous drip. (See Figure IV.)

X-ray examination of the sinuses on October 17, 1944, showed some mucosal thickening still present in the right antrum. (See Figure VIIIB.) Right antrum proof punctures were done on October 21, 1944, and October 30, 1944, and the returns were found to be clear.

Case E.

The patient complained of nasal discharge for three months and of nasal obstruction for two months. On examination of the nose, mucopus was seen on the left side. X-ray examination of the sinuses on October 5, 1944, showed a uniform lack of translucency in both antra. (See Figure IXA.) There was some loss of translucency also in the left ethmoid and lower half of the left frontal sinus. Double proof puncture on October 9, 1944, produced on the right side a cloudy, offensive return, whilst on the left side the return was very cloudy. The cultures grown from these returns contained on the right side a moderate growth of hæmolytic *Staphylococcus aureus* and diphtheroids, and on the left a mixed growth of hæmolytic *Staphylococcus aureus* and β-hæmolytic streptococci.

Treatment.—Intramuscular injections of penicillin were commenced on October 13, 1944; 4·0 cubic centimetres of a solution of 5,000 units per cubic centimetre were injected every three hours for seven days. Proof punctures, which were done every second day, showed an improvement on each occasion until October 21, 1944, when the return from the right side was clear and the return from the left contained only a very small blob of mucopus.

X-ray examination of the sinuses on October 24, 1944, revealed considerable improvement in both antra. (See Figure IXB.) The frontals and ethmoids were clear. Double antrum proof puncture on October 26, 1944, showed the right and left sides to be clear.

TABLE II.

Summary of 79 Cases Treated.

Case Number.	X-Ray Changes in Sinuses.	Antrum Wash-Out.		Culture.	Penicillin Treatment.	Result.
		Before Treatment.	After Treatment.			
1	Right antrum.	Right antrum proof puncture: Moderate blob, and few shreds.	Right antrum proof puncture: Moderate blob.	Green-zoned streptococcus and *Bacillus pyocyaneus*.	Instillation and drops .. .. 10 days Rest .. .. 5 days Instillation and drops .. .. 15 days	Unrelieved—rash on face.
2	Right antrum.	Right antrum proof puncture: Cloudy and shreds.	Right antrum proof puncture: Clear.	Hæmolytic *Staphylococcus aureus*. Green-zoned streptococcus.	Instillation and drops .. .. 8 days	Relieved.
3	Right antrum, ethmoids and frontal.	Right antrum proof puncture: Frank pus.	Right antrum proof puncture: Clear.	Green-zoned streptococcus.	Instillation and drops .. .. 11 days	Relieved.
4	Right and left antra.	Right antrum proof puncture: Moderate blob. Left antrum proof puncture: Very few shreds.	Double antrum proof puncture: Clear.	Hæmolytic *Staphylococcus aureus*.	Displacement and drops .. .. 15 days	Improved.
5	Right and left antra, right ethmoids and frontal.	Right antrum proof puncture: Small blob. Left antrum proof puncture: Moderate blob.	Right antrum proof puncture: Clear. Left antrum proof puncture: Moderate blob.	*Streptococcus viridans*, *Staphylococcus albus*.	Sulphamerazine, medium course: Displacement, drops and instillation .. 5 days	Unrelieved.
6	Right and left antra.	Right antrum proof puncture: Clear. Left antrum proof puncture: Few shreds.	Right antrum proof puncture: Clear. Left antrum proof puncture: Very small blob.	Pneumococcus, *Bacillus pyocyaneus*.	Displacement and drops, 4-hourly 10 days	Clinically relieved, and no improvement in X-ray changes.
7	Left antrum.	Left antrum proof puncture: Cloudy.	Left antrum proof puncture: Moderate blob.	*Bacillus coli*.	Instillation and displacement .. 6 days	Unrelieved.
8	Nil.	Nasal swabbing.	——	Hæmolytic *Staphylococcus aureus* (nose).	Displacement and drops .. .. 6 days	Clinically relieved.
9	Right and left antra.	Right antrum proof puncture: Clear. Left antrum proof puncture: Small blob (osteum blocked)	Double antrum proof puncture: Clear.	*Bacillus pyocyaneus*.	Sulphamerazine, full course. Drops, 500, displacement .. 10 days Instillation .. 3 days	Relieved.
10	Right and left antra.	Double antrum proof puncture: Cloudy and offensive; numerous shreds.	Right antrum proof puncture: Large blob. Left antrum proof puncture: Large blob, cloudy.	Pneumococcus, *Streptococcus viridans* and *Bacillus pyocyaneus*.	Sulphamerazine, full course. Instillation and drops .. .. 10 days	Unrelieved.
11	Left frontal and antrum.	Left antrum proof puncture: Clear.	——	No growth.	Sulphamerazine, full course. Drops .. .. 10 days	Unrelieved.

TABLE II.—*Continued.*

Summary of 79 Cases Treated.—Continued.

Case Number.	X-Ray Changes in Sinuses.	Antrum Wash-Out.		Culture.	Penicillin Treatment.	Result.
		Before Treatment.	After Treatment.			
12	Right antrum.	Right antrum proof puncture: Cloudy.	Right antrum wash-out through intranasal opening: Clear.	*Streptococcus viridans.*	Instillation .. 3 days	Unrelieved.
13	Right and left antra and frontals.	Right antrum proof puncture: Cloudy. Left antrum proof puncture: Frank pus.	Right antrum proof puncture: Clear. Left antrum proof puncture: Small blob.	β-hæmolytic streptococcus, *Bacillus coli* and *Bacillus pyocyaneus.*	Instillation .. 5 days	Improved.
14	All anterior sinuses (right and left, antrostomy, 1943).	Double antrum wash-out through intranasal opening: Large blob.	Double antrum wash-out through intranasal opening: Large blob.	Green-zoned streptococcus and diphtheroids.	Drops and instillation .. 5 days Sulphamerazine, medium course.	Right and left antra reopened.
15	Right antrum and ethmoid.	Right antrum proof puncture: Frank pus.	Right antrum proof puncture: Clear.	Pneumococcus (type 3).	Drops and instillation .. .. 5 days Sulphamerazine, full course.	Relieved.
16	Left frontal (fluid level).	——	——	*Streptococcus viridans.*	Drops .. .. 6 days Sulphamerazine, full course.	Relieved.
17	Right and left antra.	Right antrum proof puncture: Moderate blob. Left antrum proof puncture: Few shreds.	Double antrum proof puncture: Clear.	*Streptococcus viridans* and *Staphylococcus albus.*	Drops and instillation .. .. 10 days	Relieved.
18	All anterior sinuses.	Right antrum proof puncture: Moderate blob. Left antrum proof puncture: Small blob.	Double antrum proof puncture: Few shreds.	*Streptococcus viridans*, hæmolytic *Staphylococcus aureus*, diphtheroids, *Bacillus pyocyaneus.*	Displacement .. 10 days Drops and instillation .. .. 6 days	Improved.
19	Right and left antra, ethmoids and frontals.	Right antrum proof puncture: Moderate blob. Left antrum proof puncture: Few shreds.	Double antrum proof puncture: Clear.	Pneumococcus (type 8).	Displacement .. 4 days	Relieved; rash on face.
20	Right and left antra.	Right antrum proof puncture: Slightly cloudy. Left antrum proof puncture: Small blob.	Right antrum proof puncture: Very few shreds. Left antrum proof puncture: Clear.	Hæmolytic *Staphylococcus aureus*, green-zoned streptococcus.	Instillation .. 5 days	Relieved.
21	Right and left antra.	Right antrum proof puncture: Small blob. Left antrum proof puncture: Moderate blob.	Double antrum proof puncture: Small blob.	Green-zoned streptococcus.	Drops and instillation .. .. 6 days	Clinically relieved, and no improvement in X-ray changes.

TABLE II.—*Continued.*

Summary of 79 Cases Treated.—Continued.

Case Number.	X-Ray Changes in Sinuses.	Antrum Wash-Out.		Culture.	Penicillin Treatment.	Result.
		Before Treatment.	After Treatment.			
22	Right and left antra, left frontal and ethmoids.	Left antrum proof puncture: Offensive pus. Right antrum proof puncture: Small blob.	Left antrum proof puncture: Small blob. Right antrum proof puncture: Two small blobs.	Green-zoned streptococcus.	Sulphamerazine, full course. Drops and instillation .. .. 15 days	Relieved.
23	Right antrum.	Right antrum proof puncture: Cloudy. Left antrum proof puncture: Very few shreds.	Right antrum proof puncture: Clear.	No growth.	Sulphamerazine, full course. Drops and instillation .. .. 5 days	Relieved.
24	All antra.	Double antrum proof puncture: Clear.	——	No growth.	Sulphamerazine, full course. Drops and displacement 5 days	Relieved.
25	Right and left antra.	Double antrum proof puncture: Clear.	——	No growth.	Drops and displacement .. 5 days	Relieved.
26	Post-operative changes in antra and all anterior sinuses.	Double antrum wash-out through intranasal opening: Moderate blob.	Double antrum wash-out through intranasal opening: Few shreds.	No growth.	Sulphamerazine, full course. Drops .. .. 10 days	Clinically improved, and no improvement in X-ray changes.
27	Right and left antra.	Right antrum proof puncture: Small blob. Left antrum proof puncture: Clear.	Double antrum proof puncture: Clear.	*Staphylococcus albus*, *Bacillus influenzæ*.	Drops and displacement .. 5 days	Relieved.
28	Right and left antra.	Double antrum proof puncture: Moderate blob.	Double antrum proof puncture: Moderate blob.	Green-zoned streptococcus.	Drops and instillation, 2,500 6 days	Unrelieved.
29	Left antrum and frontal.	Right antrum proof puncture: Clear. Left antrum proof puncture: Small blob.	Double antrum proof puncture: Clear.	Green-zoned streptococcus, *Bacillus coli* and *Bacillus influenzæ*.	Drops and instillation .. .. 6 days	Relieved.
30	Right and left antra and ethmoids.	Right antrum proof puncture: Small blob. Left antrum proof puncture: Clear.	Right antrum proof puncture: Clear.	*Staphylococcus aureus*.	Drops .. .. 5 days Instillation .. 2 days	Relieved.
31	Left antrum, ethmoids and frontal (fluid level).	Left antrum proof puncture: Small blob.	Left antrum proof puncture: Clear.	*Staphylococcus aureus*.	Drops and instillation .. .. 5 days	Relieved.
32	Left antrum.	Left antrum proof puncture: Few shreds.	Left antrum proof puncture: Clear.	β-hæmolytic streptococcus, green-zoned streptococcus.	Drops and instillation .. .. 5 days	Clinically improved, and no improvement in X-ray changes.

TABLE II.—*Continued.*

Summary of 79 Cases Treated.—Continued.

Case Number.	X-Ray Changes in Sinuses.	Antrum Wash-Out.		Culture.	Penicillin Treatment.	Result.
		Before Treatment.	After Treatment.			
33	Right and left antra.	Right antrum proof puncture: Small blob. Left antrum proof puncture: Clear.	Right antrum proof puncture: Small blob.	Green-zoned streptococcus.	Drops and instillation, 2,500 units per cubic centimetre .. 6 days	Unrelieved.
34	Perforated septum, nil.	Double antrum proof puncture: Clear.	——	*Staphylococcus aureus*, β-hæmolytic streptococcus.	Drops, 2,500 units per cubic centimetre .. .. 3 days	Unrelieved; rash on face.
35	Right antrum and ethmoid.	Right antrum proof puncture: Cloudy.	Right antrum proof puncture: Clear.	*Staphylococcus aureus*, β-hæmolytic streptococcus.	Continuous irrigation .. .. 24 hours Drops and instillation .. .. 3 days	Relieved.
36	Right and left antra.	Right antrum proof puncture: Moderate blob. Left antrum proof puncture: Clear.	Right antrum proof puncture: Slightly cloudy.	Green-zoned streptococcus.	Drops and instillation, 1,000 units per cubic centimetre .. 4 days	Radical antrostomy.
37	Left antrum.	Left antrum proof puncture: Moderate blob.	Left antrum proof puncture: Two small blobs.	Green-zoned streptococcus.	Drops and instillation, 2,500 units per cubic centimetre .. 6 days	Improved.
38	Right and left antra.	Right antrum proof puncture: Clear. Left antrum proof puncture: Moderate blob.	Left antrum proof puncture: Very small blob.	β-hæmolytic streptococcus.	Intramuscular injections, 1,040,000 units. Drops and instillation .. .. 7 days	Improved.
39	Left antrum.	Right antrum proof puncture: Clear. Left antrum proof puncture: Moderate blob.	Double antrum proof puncture: Clear.	Green-zoned streptococcus, *Bacillus influenzæ*.	Drops and instillation .. .. 4 days	Relieved.
40	Left antrum, ethmoids and frontal (fluid level).	Left antrum proof puncture: Few shreds.	Left antrum proof puncture: Clear.	Hæmolytic *Staphylococcus aureus*, *Bacillus influenzæ*.	Drops and displacement, 2,500 units per cubic centimetre .. 5 days	Relieved.
41	Right and left antra.	Right antrum proof puncture: Cloudy. Left antrum proof puncture: Small blob.	Double antrum proof puncture: Clear.	*Staphylococcus aureus*, hæmolytic *Staphylococcus albus*, green-zoned streptococcus.	Intramuscular injections, 4 cubic centimetres, 3-hourly, 5,000 units per cubic centimetre .. 6 days	Relieved.
42	All anterior sinuses.	Right antrum proof puncture: Clear. Left antrum proof puncture: Moderate blob.	Double antrum proof puncture: Clear.	Hæmolytic and non-hæmolytic staphylococcus, *Staphylococcus albus*, green-zoned streptococcus.	Intramuscular injections, 1,080,000 units .. .. 7 days	Relieved.

TABLE II.—*Continued.*

Summary of 79 Cases Treated.—Continued.

Case Number.	X-Ray Changes in Sinuses.	Antrum Wash-Out.		Culture.	Penicillin Treatment.	Result.
		Before Treatment.	After Treatment.			
43	Pansinusitis.	Right antrum proof puncture: Few shreds. Left antrum proof puncture: Cloudy.	Right antrum proof puncture: Numerous shreds. Left antrum proof puncture: Cloudy.	Hæmolytic *Staphylococcus aureus*.	Drops twice daily and instillation, 5,000 units per cubic centimetre 6 days	Unrelieved.
44	All anterior sinuses.	Right antrum proof puncture: Moderate blob. Left antrum proof puncture: Clear.	Double antrum proof puncture: Clear.	No growth.	Intramuscular injections, 1,120,000 units .. .. 7 days	Relieved.
45	Right and left antra, ethmoids and frontals.	Double antrum proof puncture: Moderate blob.	Double antrum proof puncture: Moderate blob and cloudy.	Pneumococcus.	Intramuscular injections, 1,250,000 units .. .. 8 days	Unrelieved; bilateral radical antrostomy.
46	Right and left antra, ethmoids and frontals.	Double antrum proof puncture: Cloudy and offensive.	Double antrum proof puncture: Clear.	Hæmolytic *Staphylococcus aureus*, diphtheroids, β-hæmolytic streptococcus.	Intramuscular injections, 1,300,000 units .. .. 8 days	Relieved.
47	Nil.	Nasal swabbing.	Nasal swabbing.	Hæmolytic *Staphylococcus aureus*.	Displacement .. 3 days Intramuscular injections .. 7 days Drops .. .. 6 days	Clinically relieved.
48	Left antrum.	Right antrum proof puncture: Cloudy and offensive. Left antrum proof puncture: Clear.	Right antrum proof puncture: Small blob.	Green-zoned streptococcus, diphtheroids.	Instillation, 1,000 7 days	Relieved.
49	All anterior sinuses.	Right antrum proof puncture: Large blob. Left antrum proof puncture: Moderate blob, cloudy.	Right antrum proof puncture: Moderate blob. Left antrum proof puncture: Small blob.	Hæmolytic *Staphylococcus aureus*.	Intramuscular injections, 4 cubic centimetres, 3-hourly, 5,000 units per cubic centimetre .. 8 days Instillation, 1,000 units per cubic centimetre .. 8 days	Slight improvement.
50	Right antrum.	Double antrum proof puncture: Moderate blob.	Right antrum proof puncture: Small blob. Left antrum proof puncture: Clear.	Hæmolytic *Staphylococcus aureus*, green-zoned streptococcus.	Instillation .. 4 days	Relieved.
51	Pansinusitis.	Right antrum wash-out through intranasal opening: Few shreds. Left antrum wash-out through intranasal opening: Clear.	Right antrum wash-out through intranasal opening: Very few shreds.	Pneumococcus (type 3)	Displacement, 1,000 units per cubic centimetre .. 5 days	Slight improvement.
52	Right and left antra.	Right antrum proof puncture: Cloudy. Left antrum proof puncture: Clear.	Double antrum proof puncture: Clear.	β-hæmolytic streptococcus.	Instillation and drops .. .. 6 days	Relieved.

TABLE II.—*Continued.*

Summary of 79 Cases Treated.—Continued.

Case Number.	X-Ray Changes in Sinuses.	Antrum Wash-Out.		Culture.	Penicillin Treatment.	Result.
		Before Treatment.	After Treatment.			
53	Right and left antra.	Right antrum proof puncture: Small blob. Left antrum proof puncture: Moderate blob.	Double antrum proof puncture: Clear.	Hæmolytic *Staphylococcus aureus*.	Instillation and drops, 2-hourly, 1,000 units per cubic centimetre 5 days	Relieved.
54	Right antrum.	Right antrum proof puncture: Cloudy. Left antrum proof puncture: Clear.	Right antrum proof puncture: Clear.	Pneumococcus.	Instillation and drops, 1,000 units per cubic centimetre .. 5 days	Relieved.
55	Pansinusitis.	Double antrum proof puncture: Clear.	——	Hæmolytic *Staphylococcus aureus*.	Displacement and drops, 2-hourly, 1,000 and "Merthiolate" .. 10 days	Improved.
56	Clear.	Nasal swabbing.	Nasal swabbing.	Hæmolytic *Staphylococcus aureus*.	Displacement and drops, 2-hourly, 1,000 and "Merthiolate" .. 10 days	Relieved.
57	Right and left antra, left frontal.	Left antrum proof puncture: Very large blob.	Left antrum proof puncture: Small blob.	Pneumococcus.	Instillation, 1,000 units per cubic centimetre .. 5 days	Slight improvement.
58	Right and left antra.	Right antrum proof puncture: Clear. Left antrum proof puncture: Small blob and few shreds.	Left antrum proof puncture: Very small blob.	Hæmolytic *Staphylococcus aureus*.	Instillation and drops, 1,000 .. 5 days Sulphamerazine, full course.	Relieved.
59	Clear.	Nasal swab.	——	Hæmolytic *Staphylococcus aureus*.	Drops and displacement .. 6 days	Relieved.
60	Pansinusitis.	Right antrum proof puncture: Moderate blob. Left antrum proof puncture: Cloudy and few shreds.	Right antrum proof puncture: Small blob. Left antrum proof puncture: Very small blob.	Pneumococcus.	Instillation and drops .. .. 5 days Rest .. .. 15 days Instillation and drops .. .. 5 days	Clinically improved and no improvement in X-ray changes.
61	Left antrum.	Double antrum proof puncture: Clear.	——	Pneumococcus and green-zoned streptococcus.	Displacement and drops .. .. 5 days	Relieved.
62	Clear.	Double antrum proof puncture: Clear.	——	Pneumococcus and diphtheroids.	Drops, 2-hourly 6 days	Clinically relieved and no improvement in X-ray changes.

TABLE II.—*Continued.*

Summary of 79 Cases Treated.—Continued.

Case Number.	X-Ray Changes in Sinuses.	Antrum Wash-Out.		Culture.	Penicillin Treatment.	Result.
		Before Treatment.	After Treatment.			
63	Right antrum; tooth root.	Right antrum proof puncture: Offensive pus.	Right antrum proof puncture: Clear.	Green-zoned streptococcus, hæmolytic bacillus.	Instillation and drops .. .. 5 days Tooth root removed. Continuous irrigations .. .. 24 hours Instillation .. 1 day Instillation, "Solutox" .. 4 days Continuous irrigations .. .. 24 hours Instillation, "Solutox" .. 5 days	Relieved.
64	Left antrum and frontal.	Left antrum wash-out through intranasal opening: Small blob.	Left antrum wash-out through intranasal opening: Moderate blob.	β-hæmolytic streptococcus, hæmolytic *Staphylococcus aureus*.	Displacement and drops .. .. 10 days	Unrelieved.
65	Clear.	Double antrum proof puncture: Moderate blob.	Double antrum proof puncture: Moderate blob.	Pneumococcus and *Bacillus influenzæ pyocyaneus*.	Displacement and drops .. .. 5 days	Unrelieved.
66	Right and left antra.	Double antrum proof puncture: Clear.	——	Hæmolytic staphylococcus.	Submucous resection of septum and resetting of nasal bones. Drops .. .. 5 days Intramuscular injections .. 6 days	Relieved.
67	Right and left antra.	Double antrum proof puncture: Frank pus.	Right antrum proof puncture: Few shreds. Left antrum proof puncture: Clear.	*Staphylococcus albus*.	Instillation .. 5 days Instillation .. 5 days	Relieved.
68	Clear.	Right antrum proof puncture: Clear. Left antrum proof puncture: Large blob.	Right antrum proof puncture: Very small blob. Left antrum proof puncture: Small blob.	Pneumococcus, paracolon organism.	Instillation .. 5 days	Relieved.
69	Right antrum, ethmoid and frontal.	Right antrum proof puncture: Frank pus.	Right antrum proof puncture: Small blob.	Hæmolytic *Staphylococcus aureus*.	Continuous irrigations .. .. 12 hours Instillation .. 3 days	Relieved.
70	Right and left antra.	Right antrum proof puncture: Moderate blob. Left antrum proof puncture: Cloudy and offensive.	Right antrum proof puncture: Small blob. Left antrum proof puncture: Moderate blob.	*Staphylococcus albus*, hæmophilus organism.	Instillation .. 7 days	Unrelieved.

TABLE II.—*Continued.*

TABLE II.—*Continued.*

Summary of 79 Cases Treated.—Continued.

Case Number.	X-Ray Changes in Sinuses.	Antrum Wash-Out.		Culture.	Penicillin Treatment.	Result.
		Before Treatment.	After Treatment.			
71	Right and left antra.	Right antrum proof puncture: Numerous shreds. Left antrum proof puncture: Small blob, cloudy.	Double antrum proof puncture: Moderate blob.	Green-zoned streptococcus and hæmolytic *Staphylococcus aureus*.	Instillation .. 5 days "Solutox" .. 2 days	Clinically relieved and no improvement in X-ray changes.
72	Right and left antra, right ethmoid and frontal.	Right antrum proof puncture: Cloudy and offensive. Left antrum proof puncture: Moderate blob and shreds.	Right antrum proof puncture: Moderate blob, cloudy. Left antrum proof puncture: Moderate blob.	Green-zoned streptococcus.	Instillation .. 4 days Continuous irrigations .. .. 12 hours "Solutox" .. 4 days	Unrelieved.
73	Right and left antra.	Right antrum proof puncture: Small blob. Left antrum proof puncture: Moderate blob.	Double antrum proof puncture: Small blob.	β-hæmolytic streptococcus.	Instillation and drops .. .. 6 days	Clinically relieved and no improvement in X-ray changes.
74	Right and left antra.	Right antrum proof puncture: Clear. Left antrum proof puncture: Small blob.	Double antrum proof puncture: Clear.	β-hæmolytic streptococcus.	Intramuscular injections, 4 cubic centimetres 3-hourly, 5,000 units per cubic centimetre .. 6 days	Relieved.
75	Left antrum.	Left antrum proof puncture: Cloudy and offensive.	Left antrum proof puncture: Moderate blob.	Diphtheroids, hæmolytic *Staphylococcus aureus* and green-zoned streptococcus.	Continuous irrigations .. .. 24 hours Instillation .. 3 days "Solutox" .. 4 days	Unrelieved.
76	Right and left antra, right frontal.	Right antrum proof puncture: Small blob. Left antrum proof puncture: Small blob.	Right antrum proof puncture: Small blob. Left antrum proof puncture: Small blob.	Pneumococcus, *Staphylococcus albus*.	Intramuscular injections, 4 cubic centimetres, 3-hourly, 5,000 units per cubic centimetre .. 7 days	Unrelieved.
77	Right antrum and frontal.	Right antrum proof puncture: Cloudy and offensive.	Right antrum proof puncture: Clear.	Hæmolytic *Staphylococcus aureus*, *Staphylococcus albus*.	Instillation .. 6 days Intramuscular injections, 4 cubic centimetres, 3-hourly .. 7 days	Relieved.
78	Right and left antra (post-operative), left ethmoid and frontal.	Double antrum wash-out through intranasal opening: Moderate blob.	Double antrum wash-out through intranasal opening: Moderate blob.	*Staphylococcus albus*, anaerobic streptococcus.	Intramuscular injections, 4 cubic centimetres 3-hourly, 5,000 units per cubic centimetre .. 6 days	Unrelieved.
79	Right and left antra, ethmoids and frontals.	Right antrum proof puncture: Few shreds. Left antrum proof puncture: Very small blob.	Double antrum proof puncture: Clear.	β-hæmolytic streptococcus, hæmolytic *Staphylococcus aureus*. ..	Sulphamerazine, low course. Drops .. .. 10 days	Relieved.

Case F.

This patient experienced nasal discharge for four years. On examination mucopus was seen in the naso-pharynx and in both sides of the nose. X-ray examination on June 2, 1944, indicated mucosal hypertrophy in both antra and ethmoids; the frontals were found to be undeveloped. The proof puncture resulted in a cloudy, offensive return from both antra, and this in turn grew a pure culture of pneumococcus.

FIGURE IXA. Opacity of right and left antra.

Treatment consisted of a high course of sulphamerazine and numerous antrum washes over a period of twelve weeks, without much improvement. Penicillin instillation, together with drops and displacement, produced no further favourable result in the following fifteen days. However, a growth of *Bacillus pyocyaneus* was obtained, which disappeared on the cessation of penicillin treatment. This in turn resulted in the reappearance of a growth of pneumococcus.

The final antrum wash before the patient was discharged showed a large blob of mucopus with a cloudy return. Penicillin did not benefit this patient at all and he was discharged from the army with a recommendation to seek operative treatment at a later date.

CONCLUSION.

1. The majority of patients treated with penicillin claimed relief from symptoms and showed improvement on X-ray examination. However, the greater proportion of these would have responded to ordinary conservative treatment. Only a small minority could conscientiously claim that their relief was primarily induced by penicillin.

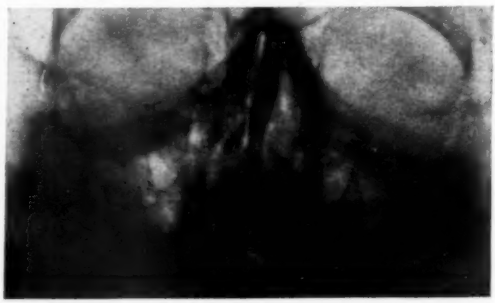

FIGURE IXB. Increased translucency in right and left antra following intramuscular injection of penicillin.

2. Three patients, from whose antral washes a pure penicillin-sensitive organism was grown before treatment, grew a culture of *Bacillus pyocyaneus* after prolonged penicillin treatment.

3. Three patients developed a rash in the vicinity of the nasal vestibule, which cleared after the cessation of penicillin treatment.

4. Penicillin was found beneficial in subduing secondary infection of the nasal passages following a common cold.

5. In the treatment of patients complaining of symptoms of sinusitis, X-ray examination was found most helpful not only in the diagnosis of sinusitis, but also in ascertaining which sinuses were involved. Only by X-ray investigation can one decide which method of applying penicillin would be most efficacious in the treatment of each particular patient.

6. Penicillin, whilst helpful in the treatment of acute and subacute exacerbations, cannot produce any permanent relief in the presence of gross chronic infective mucosal changes. Only temporary relief from secondary infection can be hoped for in the case of patients suffering from allergic

stimuli. Nor can patients possessing antro-oral fistula, foreign body in the antrum, or conditions producing stasis in the nasal passages or accessory sinuses, hope for freedom from recurrence of infection if penicillin treatment alone is undertaken.

ACKNOWLEDGEMENTS.

I thank Major G. C. Scantlebury for his encouragement and helpful criticism. Also I express my gratitude to Mr. Hume for his drawings, and to those departments of 115 Heidelberg Military Hospital (Victoria) which helped me.

REFERENCE.

(1) C. H. Rammelkamp and C. S. Keefer: "Absorption, Excretion, and Distribution of Penicillin", *Journal of Clinical Investigation*, Volume XXII, May, 1943, page 425.

THE NATURE OF THE PILONIDAL SINUS.[1]

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PILONIDAL SINUS, with the associated cyst or abscess, had been receiving considerable attention prior to 1939 and increased in importance during the war. In the literature the frequency and disabling character of the condition have been emphasized repeatedly.

Whether this condition was more common amongst soldiers than among civilians may be open to doubt, but it is clear that many more cases were observed in the army than amongst a comparable number of people in civil life.

The condition is disabling, particularly in units on active service, and not easy to treat adequately. The variety of procedures recommended for its cure clearly indicates the unsatisfactory nature of any one of them. The prevention of complications of this condition therefore is of paramount importance. The possibility of such prevention depends on the nature of the condition. For this reason the problem is reviewed here and certain conclusions are set out.

GENERAL CONSIDERATIONS.

This condition is a small pit in the mid-line skin of the sacro-coccygeal region, usually found in young adults. Though in itself small and negligible, its complications demand that attention be directed to it. It is found in various forms, which are either stages in its development or the direct result of complications. Some of these are often regarded as the essential condition and earlier and smaller forms are ignored.

There is a great deal of confusion in the ideas regarding the mode of origin. This is because an origin is assumed without any real reference being made to peculiarities of the condition itself. It is practically always accepted that the condition is a "congenital" one. The earliest accounts, during the last century, show various features which can be demonstrated easily and which give a clear indication of a different nature. Curiously enough, these have been ignored, and it must be admitted that the writer did not know of these accounts until several observations caused him to search the literature specially. Even the implication behind the name pilonidal (a "nest" of hair and not a growth of hair) is overlooked.

It is considered that the "congenital" view is demonstrably wrong, and for this reason the problem is examined and discussed here. An account of the condition is given, the developmental view is discussed in the light of these observations and discarded, and finally an hypothesis which is supported by them is adduced.

OBSERVATIONS ON PILONIDAL SINUS.

The pilonidal sinus may be a tiny crypt or a relatively large sinus; it may be single or multiple. It occurs in several sites and gradually increases in size. Infection and fistula formation occur and the presence of hair in some of the larger fistulæ is a characteristic feature. These are now discussed.

[1] Accepted for publication on June 4, 1946.

1. *Incidence.*

The condition is found most commonly in males (70% to 80%) and usually in the third decade. Individuals who are fat, hairy and show considerable sebaceous gland activity are most frequently affected. The condition is commoner in hot and moist climates, and especially in individuals subjected to frequent mechanical irritation of the region—drivers, typists *et cetera*. This has been emphasized by American writers in the use of the term "jeep disease".

2. *The Small Lesion.*

On clinical examination the smallest sinuses are seen to be minute, extending only for a millimetre or so into the deeper tissues, that is, just into the dermis and not into the subcutaneous tissue (Figure I). A hair may be seen projecting from the opening and if this be removed it is found to have a typical root, that is, it is actually growing in the depths of the sinus. It should be emphasized that this is to be observed only in the smallest sinuses. In no other is a hair ever found growing (see section 7). A sinus observed over a period of time may be found to increase gradually in size and depth.

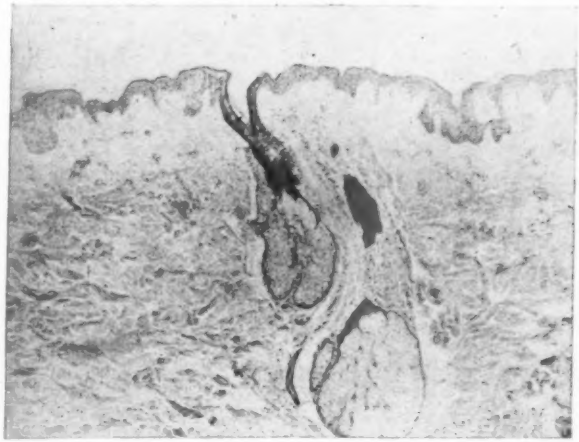

FIGURE I. Photomicrograph of a section through a small but clinically typical pilonidal sinus which is developing by widening of a hair follicle. Enlarged sebaceous and sudoriferous glands are shown. ×12.

Microscopically the condition consists of a sinus lined by typical squamous epithelium which runs continuously into the epithelium of a hair follicle (when such is present). A hair actually growing is seen in some passing along the sinus to the exterior, but some crypts are quite unrelated to hair follicles. Inflammatory changes in the adjacent tissues may be seen; though round small sinuses, they may be negligible. There is sometimes evidence of previous inflammation now subsided.

3. *Multiple Lesions.*

A point that is insufficiently emphasized in most accounts of the condition is that more than one sinus (sometimes six or more) is found.

Although usually of similar size and conformation, these may be of different sizes and show slightly different characteristics (Figure II). Comparison of these strongly suggests that the differences are explicable as stages of development. Microscopic examination of one excised area containing several lesions may provide evidence of the mode of evolution.

Histologically, sinuses, small but larger than those mentioned previously, extend well into the dermis and have larger sebaceous glands associated with them. There are usually collections of wandering cells in the neighbourhood of the sinus wall and the sebaceous glands. Occasionally sudoriferous glands are prominent.

Still larger sinuses extend definitely into the subcutaneous tissues and, extending into the subcutaneous tissues well beyond the extremity of the sinus, are numerous sudoriferous glands. These often extend in a direction parallel with the skin. Some of the larger sinuses possess an epithelial lining for only part of their extent, the remainder of the free surface of the sinus being granulation tissue.

4. *Consecutive Lesions.*

A certain proportion of "recurrences" of pilonidal sinuses after excision can be shown to be due to associated sinuses rather than the redevelopment of the previously treated one. The new sinus is quite distinct from any

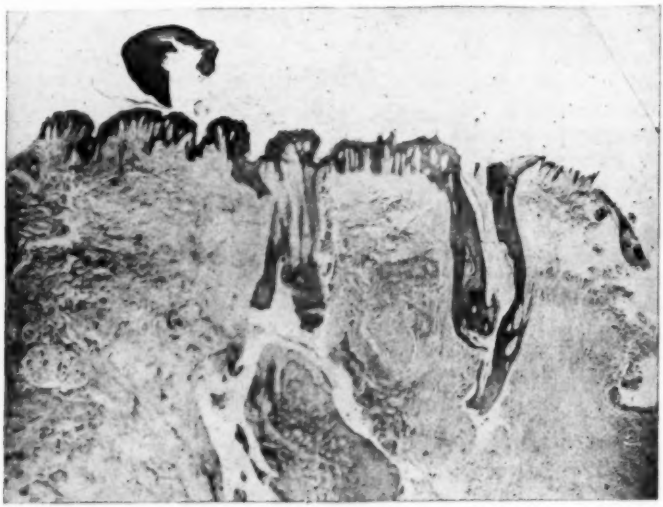

FIGURE II. Photomicrograph of a section showing two adjacent sinuses. The left-hand one (not cut through its centre) has an abscess at its base. The right-hand one contains debris. × 12.

previous sinus, sometimes being at a distance of as much as an inch from the end of the operation scar, and does not in any way communicate with the previously involved area. Such cases have been carefully investigated in view of the possibility of portion of a sinus or fistula having been left behind. This does occur, but has been excluded in the cases mentioned by serial microscopic sections of the tissue between the sinus and the area of the previous operation.

In some cases a small lesion may have been overlooked, but in others it is clear that at the original operation any similar condition in the vicinity of the sinus dealt with was negligibly small, even if present at all. This is of importance in that it indicates that a typical sinus may arise in an area which was previously normal.

5. *"Atypical" Sites.*

Sinuses are usually found in the mid-line. This, however, is not always so. They occur in a crease which is found in some individuals running for a short distance from the mid-line either above or on the gluteal fold.

Occasionally the sinus opening is to be found close to but not actually in the mid-line. These are typical sinuses and are not to be confused with

secondary openings from an infected sinus or cyst, which often are situated lateral to the mid-line.

6. *Changes in the Small Lesions.*

Attention of the patient is drawn to the sacro-coccygeal region often by discomfort, itching or mild pain. Examination at this stage shows one or more crypts, around and deep to which there is a thickening with or without redness. Some redness of the skin may be present without any definite thickening or swelling.

FIGURE III.—Photomicrograph of a section of the deep part of a pilonidal sinus. The walls are here lined by granulation tissue which contains hairs. These show no follicles but are lying naked in the connective tissue. A hair (arrow) is seen in the cavity. × 20.

Microscopic examination of these small crypts is made in tissue obtained by block dissection of a larger sinus which is accompanied by smaller sinuses. In a thickened area the crypts are deeper, wider and, when they extend into the subcutaneous tissues, are associated with a zone of wandering cells. Sweat glands are here particularly prominent. The deepening sinus extends in the direction of the sudoriferous gland proliferation. Extension of the sinus in several directions simultaneously gives a branching dendritic shape (Figure V).

The size and general distribution of these structures in this tissue indicate clearly that epithelial proliferation has occurred to a considerable degree.

7. *Presence of Hair.*

As stated previously, the minute lesions show a hair growing from a small crypt in the skin. This feature, however, is confined to the smallest lesions.

In the larger sinuses the hairs are found not to be attached to the deeper tissues by a root. Indeed, if they are removed they are found usually not to have a "root" at all. However, careful examination sometimes shows a "root", which, when found, is at the superficial and free end of the hair. It is noteworthy that the observation that the hairs grew "inwards" was made in the earliest described cases.

Microscopically the sinus wall may contain hairs, but these are not surrounded by the epithelium of a follicle (Figure III). They lie free in a granulation tissue, are often irregular in contour, and foreign-body giant cells are in close association with them (Figure IV). Other debris in the form of desquamated epithelium may also be present.

FIGURE IV. Photomicrograph showing hairs lying free in the connective tissue. There are some giant cells but no follicular epithelium. × 20.

In cases in which a sinus has been treated by excision and skin graft, a shallow depression with a wide mouth is formed. This is liable to become filled with hairs, epithelial debris and collections of fibres from garments. In patients who are not meticulously clean, an extraordinary amount of rubbish may collect and this determines irritation and infection of even such a wide-mouthed depression. It can be shown that hairs present in sinuses pass in similarly from the outside. When hairs protrude from a sinus these may be removed easily (with forceps), but a day or so later there will be a fresh crop. This may be prevented by placing an occlusive dressing above (that is, cranial to and overlapping) the sinus area.

8. *Secondary Changes.*

It is the development of complicating phenomena which makes the pilonidal sinus of clinical importance. In the absence of infection the sinus will not usually be noticed by the patient, though a history of previous irritation, swelling or pain may be obtained. Many small sinuses are found in individuals who are being examined for some other condition, for example, backache, sciatic pain *et cetera*.

Infection often occurs in the tissues immediately adjacent to the sinus, but at other times it is apparent at a distance. This may be due to the extension of the sinus for some distance from its orifice, the infection being around the deepest part of the sinus. Sometimes there is a thickening extending from the region of the sinus opening to the area of maximal inflammation. In other cases there is no obvious clinical connexion. Investigation of the intervening tissues microscopically shows either a zone of inflammatory tissue or of sweat glands connecting the two.

Suppuration often occurs in the inflamed zone. Pus escapes from the sinus opening and persistence of the discharge suggests the presence of a foreign body. The discharge of pus through the sinus is usually inadequate and the abscess bursts at a distance (sometimes considerable) from the sinus opening and thus a fistula is formed. This may become completely epithelialized.

Ramifications from the sinus may pass in several directions, but it is rare for them to pass to the sacro-coccygeal joint or into the pelvic cavity. The direction in which any extension passes is usually determined by the disposition of tissue planes, and this also explains extension to the sacro-coccygeal joint when this occurs.

Occasionally, in the absence of any demonstrable sinus, a furuncle develops in the sacro-coccygeal region, and this may persist as a discharging sinus. If allowed to continue for a time, the abscess sinus becomes epithelialized. The deepest part of a sinus may become cystic. Some of these contain debris of extraneous origin, but in others the contents are, as indicated by its general arrangement and character, a product of desquamation from the epithelialized surface.

DISCUSSION.

As stated above, it is almost invariably assumed that pilonidal sinus is a developmental anomaly of some kind. Furthermore, it is usually assumed that the disturbance of growth occurred at an early stage of fœtal life.

The reasons for this opinion are: (i) the presence of a connexion of the skin with the neural canal in early fœtal life, in the sacral region; (ii) the presence of deep sinuses extending into the vertebral canal in some young individuals; (iii) the occurrence of sacro-coccygeal dimples in some babes; (iv) the mid-line site of most sinuses; (v) the presence of hair in sinuses.

It is perhaps desirable to evaluate this evidence first. It is less than a century ago since careful and accurate observations placed our knowledge of early fœtal development on a sound footing. These observations were closely followed by a spate of facile and somewhat naïve hypotheses of the immediate relationship of many pathological conditions to stages of fœtal development. Difficulties in the correlation of disorders in adult life with possible aberrations in the first weeks of fœtal life have been glossed over and the flimsiest of circumstantial evidence has been accepted as proof of a close and significant relationship.

That an abnormal state is associated usually with a change in anatomical structure of a part is self-evident. What is less clear is that such change, apparent in adult life, must necessarily have occurred early in the life of the individual. The various arguments in favour of the "congenital" origin mentioned above will now be discussed.

(i) Often a special relationship of tissues in fœtal life is considered necessarily to determine some (preferably similar) interconnexion in post-natal life; but this view does not bear critical examination. Any anatomical structure or aggregation of tissues is significant only for a particular stage of development. This is best demonstrated in the life history of insects, but is also shown well in vertebrates. In the higher mammals a neurenteric canal, a notochord, a tail-bud, branchial clefts and many others have a significance and even exist only for a short period of development, becoming lost or obscured in a new arrangement of the tissues as different ones arise. That tissues, particularly during growth, are labile and always changing is too often overlooked. The correlation of some of the earlier structures and organs with adult form requires an imagination which rises superior to observable phenomena.

That certain features of later stages of development may persist into adult life is incontrovertible—hare-lip, duodenal obstruction, cervical rib, amongst others, are good examples—but this does not justify some vague "congenital" origin for many other post-natal developments.

Such philosophical considerations could be discussed at very great length, but all that is intended here is to emphasize that hypotheses must depend not on preconceived ideas based on quite unrelated phenomena, but on demonstrable facts.

The occurrence of a neuro-cutaneous communication in early fœtal life can be correlated intimately with skin lesions in post-natal life only by the postulate that during all the remarkable changes taking place in the region of the neurenteric canal part of these tissues is relatively unaffected. Careful study of innumerable stages of growth shows how completely earlier structures are changed into or replaced by quite different ones. Where arrest of, or aberrant, growth takes place the mode of formation is clear, as for example in *spina bifida*.

There is little resemblance between a *spina bifida* and a pilonidal sinus—the former is present at birth (that is, the stages between the fœtal form and the post-natal condition can be followed without interruption), they occupy different sites and the tissues involved are different.

(ii) Deep sinuses communicating with the spinal canal have been observed in the cervical and dorsal as well as in the lower part of the vertebral column. Significant deductions could be made from these only if crypts in the skin were found in the sites corresponding to them. This is not so; therefore the occurrence of a cutaneo-meningeal sinus in the dorsal region cannot reasonably be considered to give the clue to the formation of a cutaneous lesion in another part of the back.

(iii) Sacro-coccygeal dimples are found in some infants. If these had a direct relationship to the pilonidal sinus, one would expect some demonstrable association. On the other hand, dimples are seldom found with sinuses, and these do not at any stage of their development show morphological similarity to the dimples. The dimple, with its smooth sloping edges and shallow base, is quite different from the "pit" of the sinus; it is always single and is present at birth. The sinus definitely arises in tissues previously normal during adult life, though it is appreciated that a patient could have a sinus engrafted on an area with a dimple, but evidence of any direct ætiological association is lacking.

(iv) The mid-line site of most sinuses has appeared to support the congenital view (incomplete mid-line fusion) and might be a strong argument, if it were always true. A developmental origin for those not lying in the mid-line strains the hypothesis to breaking point.

(v) The presence of hair in the sinuses and cysts in the region is one of the characteristic features. Indeed it was what originally attracted attention to them and was responsible for the terminology used. In 1880 Hodges described the "nest" of hair and compared this collection with hair-balls in the stomach and concretions in the umbilicus.[1]

It is somewhat astonishing, therefore, to find that in almost all subsequent writings the hairs have been considered to arise locally and the extraneous origin of them has been entirely overlooked. That the hairs do not arise in the sinus itself will have been clear to any surgeon who has removed hairs from a sinus and examined them. As remarked by Hodges, "The hairs . . . are always short without bulbs", but, as previously stated, sometimes a root may be found but only at the peripheral end. In 1854 Warren[2] described the hairs as being "inverted".

Microscopically such hairs as may be embedded deep in the sinus lie free in granulation tissue without any epithelial wall and are surrounded by many wandering and giant cells, just as is any other foreign body. This

indicates that the hairs do not come from within the sinus, but are derived by desquamation of hair of the back which passes down between the buttocks and enters the sinus.

In view of the above observations further discussion is scarcely necessary. However, the argument that the presence of growing hair supports a "congenital" hypothesis, as is argued also with dermoid cysts, shows the carefree manner in which an hypothesis is built on the flimsiest evidence. Actually the presence of growing hair indicates merely the existence of a differentiated squamous epithelium and is no index of its origin, so that, even if it were applicable, would not aid the hypothesis.

Thus when we consider the arguments in favour of the developmental hypothesis, we find that the evidence is of a casually circumstantial nature and will not withstand even a superficial analysis. An hypothesis which depends on the described phenomena is now presented (Figure V).

MODE OF DEVELOPMENT.

The earliest stage of the pilonidal sinus is a tiny crypt in or near the mid-line. Such is frequently associated with an irritative condition of the skin of the region. This appears as redness and even rarely as a weeping eczematous state. It is associated with itching and in later stages pain. In many cases the itching is present without redness. The skin condition undergoes exacerbations and in the intervals between "attacks" the typical crypt may be seen without obvious adjacent skin changes. In many cases the skin condition even in active phases is of a mild and chronic character.

Microscopic examination at this stage shows some thickening of the epidermis, irregularity of the surface and numerous small depressions, the larger corresponding to those observed clinically. These may be obvious enlarged hair follicles (or sebaceous gland ducts), but may be independent of these. There is a cellular connective tissue reaction in the dermis more apparent in the neighbourhood of the depressions.

The crypts thus form as the result of skin inflammation, either by widening of hair follicles or production of depressions, which arise by irregular thickening of the epithelium, dermal and subcutaneous fibrosis and by downgrowth of the epithelium.

The formation of crypts of this kind is not peculiar to this region, but is a general phenomenon and is found elsewhere — for example, in the depression on the outer aspect of the *alæ nasi,* in the creases between folds in the neck of adipose individuals, and in the coronal sulcus of the penis amongst others. In few such cases, however, does the cause of the irritation persist or is it so continuous as in the inter-natal region.

The condition is usually due to inadequate cleaning of the skin. This is obvious in some patients of careless habits. In other cases, particularly with soldiers on active service, this is determined by difficult conditions—lack of water, inability to change clothes, and similar factors. In still others it is a relative matter—individuals of hirsute type with more than usual sebaceous gland activity may require much more frequent attention to the sacro-coccygeal region than another person.

It is clear that desquamated hairs and epithelium as well as particles of abraded clothing find their way into the inter-natal cleft. In hot climates this is added to by sweat and sebaceous secretions. These are responsible at least in part for the irritation of the skin of the area.

At this stage special attention to cleanliness of the area will result in a complete resolution of the irritative condition and tiny crypts will be observed

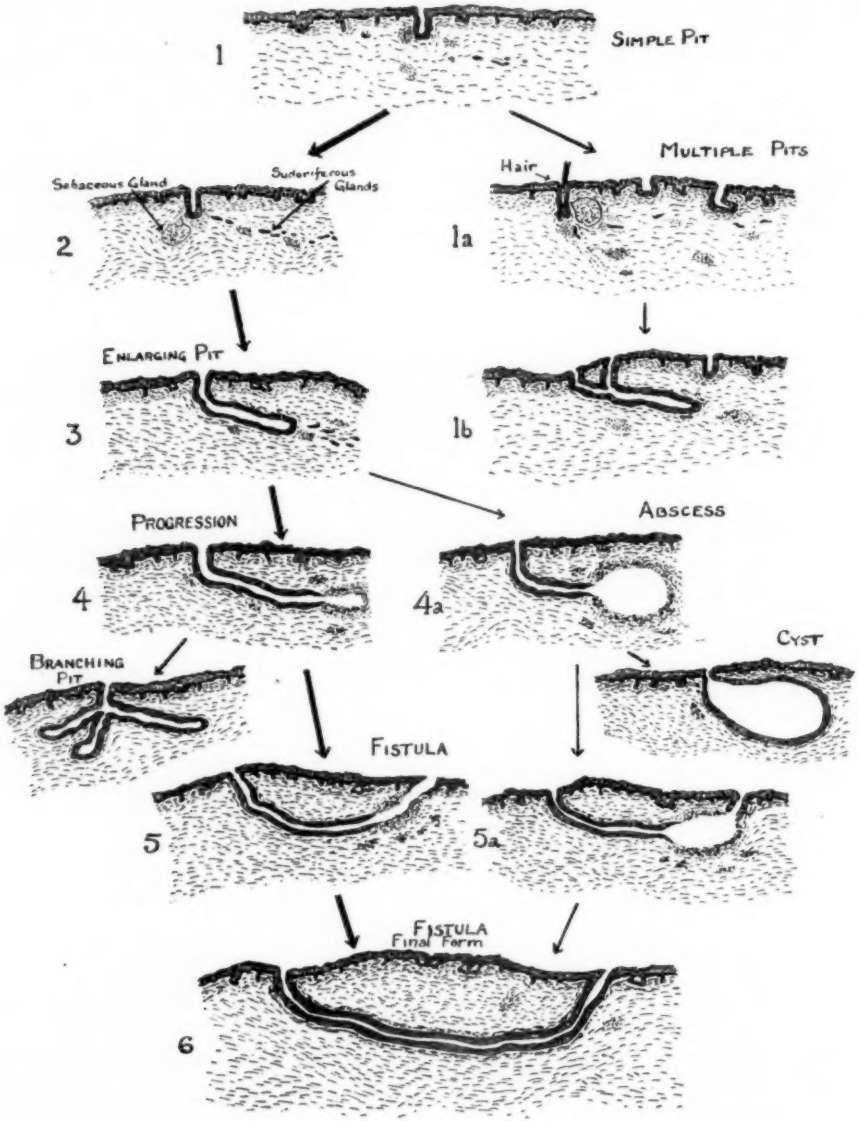

FIGURE V. Drawings to show the various stages of development of a pilonidal sinus. 1: Simple pit of epithelium. 1a: Multiple pits which arise either in hair follicles or as a depression independently of follicles or glands. 1b: With deepening of the crypt two adjacent ones may join. 2: Sebaceous and sudoriferous gland activity. Pits may enlarge by dilatation of these but in any case extend along the line of gland proliferation. 3: Enlargement of pit and extension into the deeper tissues. 4: Infection occurs at the deep part of the pit and here an abscess often develops; this may discharge into the sinus but may form a large abscess. 4a: The pit may branch in various directions. Epithelialization of an abscess cavity gives rise to an epithelium-lined cyst. 5: Infection spread through the skin at another point and a fistula is formed. This begins to epithelialize. 6: Epithelialization may become complete.

to disappear gradually. Both this recovery and the formation of crypts in skin previously normal are most cogent support for an acquired origin of the crypts.

Once the crypt is formed further progress is followed easily. It becomes the site of special irritation because foreign material passes into it and this causes further inflammatory change. This also is not peculiar to this region, since it occurs in other areas—for example, the umbilicus. It is readily demonstrable that debris or hairs may enter extremely small-mouthed sinuses. The crypt becomes wider and deeper, and there is tenderness and sometimes redness immediately round it. This is the more obvious in the cases in which general skin irritation is minimal.

Microscopic examination at this stage shows the sinus walls lined by stratified squamous epithelium which is often thickened and enlarged sebaceous glands and sudoriferous glands extending for considerable distances into the subcutaneous tissues. Around the gland tubules there are many wandering cells. Debris is obvious in the crypt, and some of this may be due to epithelial desquamation *in situ*.

The changes usually are most obvious in the deepest part of the sinus and further epithelial downgrowth of the crypt occurs along the line of inflammatory cell aggregations and the sudoriferous glands. This direction seems to be determined, at least in part, by the trends of tissue planes. The process is strictly comparable with epithelial proliferation seen elsewhere—for example, in the wall of the stomach or gall-bladder. The downgrowths may occur in more than one direction at the same time, giving a branching sinus.

In later stages epithelium is absent from the depths of the sinus, which is here lined only by granulation tissue. Whether this state of affairs is the result of destruction of the epithelium or follows an abscess development in the deepest part of the sinus (the abscess communicating with the sinus) is not specially significant; probably both phenomena occur. The granulation tissue usually contains foreign material, of which the most obvious and arresting are pieces of hair, and foreign-body giant cells are prominent.

The later stages resulting in the formation of a fistula are not usually the subject of dispute. An abscess forming in relation to the deepest part of the sinus bursts through the skin and the opening is frequently away from the mid-line.

What is important, however, is that the new part of the fistula becomes epithelialized from the adjacent skin in a manner similar to epithelialization of chronic sinuses elsewhere—for example, those in chronic osteomyelitis. That the growth is from the surface inwards is indicated by the observation that fistulæ are often seen to be lined by epithelium at each end, but not in the middle portion, where there is granulation tissue only.

This indicates an alternative method of formation of the sinuses. An abscess in the sacro-coccygeal region without any evidence of a crypt is a well-known phenomenon. It is well known also that when this bursts it is liable to become chronic or to recur and later a typical pilonidal sinus is found. When an example is first encountered, one is usually sure that a small sinus had been overlooked, but careful examination of subsequent cases shows that the originating abscess is typically a furuncle.

When the abscess bursts the extreme liability of cavities to become (in this region very rapidly) the repository of debris passing from the skin of the lumbar and sacral regions, causes it to become chronic and to persist.

In summary, the mode of development posulated here is as follows:

1. Associated with an irritation of the skin there are a crypt formation (by widening of a hair follicle or formation of a simple depression), gradual

deepening of the crypt and downgrowth of the epithelium into the subcutaneous tissue. This downgrowth is usually adumbrated by sudoriferous gland proliferation. The crypt becomes the repository of debris, including hairs (which enter the sinus from without), and these cause persistent inflammation and discharge of pus. This chronic inflammation results in further epithelial downgrowth. Acute exacerbations cause abscesses and fistulæ.

2. A furuncle or primary abscess bursting in or near the mid-line becomes in a similar manner a reservoir for foreign material. It thus becomes chronic and ultimately epithelialized.

This hypothesis, which depends on the formation of a sinus as the result of stimuli acting on adult tissues, is more in accord with observations than those contingent on fanciful relationships between adult tissues and those of early fœtal life.

The main features which conform with and support this hypothesis and are not explicable easily on any "congenital" view are: (*a*) the maximum incidence in the second and third decades; (*b*) the observation of the formation and regression of sinuses; (*c*) multiple lesions; (*d*) lesions not in the midline; (*e*) the stages of development observed in adjacent sinuses, both macroscopically and microscopically; (*f*) the presence of hair as a foreign body and not a local formation.

An important result of this view is that, in the early stages, the condition is preventible and susceptible of conservative treatment. The essential point is that due attention be paid to irritative conditions in the area. In addition, an essential part of the treatment of a developed lesion, whether an abscess or a post-operative healing area, is that particular care must be exercised to prevent the entry, since this occurs so readily here, of any foreign material into the area.

SUMMARY.

1. The general features of the various stages of the pilonidal sinus are described.

2. The "congenital" hypothesis is reviewed.

3. An alternative hypothesis is presented and the evidence for this is set out.

4. The significance of this view in treatment is briefly discussed.

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DRAINAGE IN INFECTED CAVERNOUS SINUS THROMBOSIS.[1]

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A MORTALITY RATE of almost 100% has until recent years attended cavernous sinus thrombosis. Since the introduction of the "sulpha" drugs, penicillin and heparin, however, quite a series of recoveries have been recorded. In a number of the reported cases no mention is made of the important diagnostic sign, œdema of the mastoid. It may be that the patients were taken in hand before this rather late sign appeared. In the case reported below marked mastoid œdema was present and the patient was so collapsed and near the end that it was decided to supplement the sulphadiazine and penicillin treatment with drainage of the sinus. An intravenous drip of saline solution and heparin was considered and passed over.

In past years I have had under my care three cases of cavernous sinus thrombosis. Each ended fatally. In each case mastoid œdema was present and the condition became bilateral. The infection atrium in two of the cases was furunculosis near the ala of the nose. In one of them the pustule had been incised and squeezed. In the third case infection spread from a septic ulcer in the same region, said to have followed herpes of the upper lip. The medical treatment available at the time, *plus* ordinary orbital incision, was without avail. I have in past years also treated eight patients suffering from orbital cellulitis. In each instance the infection had spread from paranasal sinusitis. Orbital incision and sinus forceps—not forgetting the pulley of the superior oblique—were used to drain the suppurating area to the nose and through the conjunctival wound. Five patients recovered completely, but in three some varying degree of visual or muscle defect persisted. One of these developed secondary optic atrophy with perception of light only.

The diagnosis between cavernous sinus thrombosis and orbital cellulitis may present some difficulties, for many of the signs and symptoms are common to both, and further, the two conditions may coexist, as thrombosis may follow cellulitis. Some points to be considered in differentiating between the two conditions are as follows: (i) An infection atrium is present in the area drained by the tributaries of the cavernous sinus, as septic infection of the face, lips, nose, brow, eyelids, teeth, nasal sinuses and erysipelas. (ii) There is a lack of paranasal sinus findings. Paranasal sinusitis is associated more commonly with orbital cellulitis. (iii) There is a loss of mobility of the globe, earlier and more marked in cellulitis. (iv) Proptosis forwards occurs in both conditions, but may also show a lateral displacement in cellulitis. (v) Œdema of the mastoid area is a certain sign of cavernous sinus involvement. (vi) Involvement of the second eye indicates sinus thrombosis, as bilateral orbital cellulitis from paranasal sinus disease is rare.

It is not the province of this paper to describe the inflow and outflow connexions of the cavernous sinus, but an appreciation of them is essential in the making of a diagnosis. An infection atrium may exist in one or other of the areas drained by the veins flowing into the sinus.

The symptoms of infected cavernous sinus thrombosis are those of a general acute infection, with varying cerebral disturbances, together with

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the local signs and symptoms. Locally there is pain in the eye, with tenderness on pressure and increasing and intense œdema of the eyelids with marked protruding chemosis as the condition progresses. The proptosis is severe and straight ahead—in two of my cases of orbital cellulitis the proptosis was forward and somewhat outward. The cornea is exposed and may be anæsthetic. The epithelium is hazy and ulceration may follow. The whole globe is more or less immobile. In spite of the fact that the third, fourth and sixth nerves are in the sinus, it is my experience that the loss of mobility is definitely less than in cellulitis. In the latter condition I consider the loss of movement is earlier in appearing and more marked in degree than in thrombosis. The causal infection focus presents its symptoms also.

I have taken a motion film of one patient with cavernous sinus thrombosis, showing the progress and development of the condition during the last two days—some movement of the globe is retained to the end. The pupil reaction and the state of the vision and fundus are of no real value in differentiating between the two conditions. If mastoid œdema appears, the diagnosis is certain. It indicates the spread of the infection along the superior petrosal sinus to the lateral sinus and so to the mastoid emissary vein. Thrombosis of one sinus crosses to the other side, via one of the intercavernous sinuses, as it did in the three fatal cases mentioned. It also showed early signs of having crossed in the case recorded below. The mastoid œdema and the affection of the second eye may be late in showing, and these signs indicate a desperate condition of the patient. However, it is demonstrated that it is still not too late for the application of the modern chemotherapeutic agents *plus* surgery to save the patient from impending dissolution.

CASE REPORT.

N.C.McK., a boy aged nine years, was admitted to hospital on February 22, 1946, with a history stating that the left eye had begun to swell six hours earlier and that now the orbital tissues were œdematous and the eye was closed. The patient's temperature was 100° F. and his pulse rate 90 per minute. A small furuncle was present under the nose and much tenderness was present over the area. The œdema involved the left upper and lower lids; moderate chemosis and proptosis were present. Heat and drops were applied to the eye, and sulphadiazine was given internally, one gramme *statim* and 0·5 gramme every four hours with alkalis.

The patient was referred to Mr. Gillies Borrie, of the ear, nose and throat department, with a provisional diagnosis of "acute left frontal sinusitis". The orbital swelling had increased and the patient became extremely dyspnœic with an expiratory squeak, and he could not be induced to speak. Nasal report was that both sides were clear. The turbinates were seen and no discharge was present. In the mouth tonsillectomy scars were seen; the pharynx and larynx were normal. The vocal cords were normal and moving equally and well. Left orbital œdema and chemosis were marked. Frontal and maxillary tenderness was present. Transillumination of both frontal and maxillary sinuses was clear. The radiologist reported that there was opacity of the right antrum and to some degree of the left frontal sinus. The patient was referred to Dr. Lawrence Ludbrook, a physician who reported that the findings were negative. He ordered penicillin, 10,000 units to be given intramuscularly every three hours, in addition to the sulphadiazine.

The patient was referred to the ophthalmic department thirty-six hours after his admission to hospital. The condition had continued to deteriorate, though penicillin and sulphadiazine were being administered. The temperature, however, was not above 102·6° F.; the pulse rate was 100. No culture was grown from the blood, perhaps, but not necessarily, owing to the drug treatment. Intense œdema of the left eyelids was present with protruding chemosis. There was marked forward proptosis with exposure of the cornea and a loss of corneal epithelium. The retinal veins were distended and there was much restriction of the mobility of the globe. Œdema of the left mastoid region with displacement of the auricle was present and some œdema of the right upper lid and slight chemosis at the region of the right caruncle appeared. There was no defect of the external rectus or loss of movement in the right eye. The diagnosis of cavernous sinus thrombosis was certain, the infection from the nasal pustule having travelled by the facial, angular and orbital veins to the sinus.

As the patient was stuporose and his general aspect extremely bad, it was decided to make an effort to drain the infected sinus. "Diseases desperate grown, by desperate appliance are relieved or not at all." Under "Pentothal" anæsthesia the œdematous lid was strongly retracted and a scissor snip was made in the chemotic conjunctiva. A pair of closed artery forceps was introduced into the wound and advanced to the apex of the orbit, to the superior orbital fissure. Here the resistance increased, but the forceps were pushed on for about half an inch, fracture of the sphenoid wings being felt distinctly. The blades were then partially opened with moderate force. The presence of the third, fourth, fifth and sixth nerves was appreciated but ignored. The internal carotid and the pituitary body it was hoped were safe from injury. Withdrawal of the instrument was followed by a small amount of faintly pus-streaked blood. A rubber drainage tube was introduced into the very depths and penicillin syringed gently through. The tube was stitched in position and the patient was returned to bed. Hourly irrigation with penicillin was subsequently carried out through the tube.

An aluminium guard with a hinge of adhesive attached to the forehead was used to protect the eye and to facilitate access for the hourly irrigation through the tube. Frequent drops of oil were applied to the conjunctiva and cornea, with an occasional drop of atropine, as well as the penicillin irrigations. The patient's temperature was 100° F. the day after operation and was never again over 100° F. The penicillin injections, though the drug was in short supply, were now increased from 10,000 units to 15,000 units given by intramuscular injection every three hours, and the sulphadiazine to 1·0 gramme every four hours for eight days, and then back to 0·5 gramme every four hours for ten days. During the treatment the patient was given 1,500,000 units of penicillin.

The bacteriologist reported the evacuated discharge as "*Staphylococcus aureus*, penicillin sensitive". A blood count during early convalescence showed the red cells to number 4,330,000 per cubic millimetre; the hæmoglobin was 12·5 grammes per 100 cubic centimetres; the colour index was 1·0 and the leucocytes numbered 12,700 per cubic millimetre. No active treatment was given to the causal furuncle—it faded away in a few days.

The constitutional improvement was well marked twenty-four hours after operation and daily improvement was maintained. The drainage tube was removed on the fifth day, though the return seemed clear after three days. The proptosis and chemosis gradually subsided and ten days later were markedly less, the cornea being almost covered by the eyelid. Mobility of the eye increased and the mastoid œdema disappeared slowly. The patient's appetite and interest in his surroundings returned and he was discharged to the out-patient department after being four weeks in hospital.

The above method of draining the inaccessible cavernous sinus in this instance was simple and effective and the final trauma is very much less than was expected. Exenteration of the orbit, even if successful, is necessarily followed by gross cosmetic deformity. The neurosurgeon may perhaps develop a finer approach to the area with safety, for though the sinus is formed by split dura, it is really extradural. No doubt the saturation of the patient with bacteriostatic drugs is responsible for my having been able to fracture the bone in a septic area with comparative impunity. From the progressive and marked failing of the patient, in spite of the drug treatment, we feared he would not survive and thought that it was imperative that some effort should be made to carry out the old surgical maxim: "Where there is pus, let it out."

In order to be certain that the cavernous sinus was drained, with Dr. W. Gilmour, pathologist to the hospital, I afterwards carried out the same procedure on the cadaver, leaving the forceps *in situ*. After removal of the brain, the forceps blades were found exactly in the sinus.

That the trauma inflicted by the disease and surgery is surprisingly small is evidenced by the present condition of the patient, six months later. The boy is attending school, is well and thriving physically. The *levator palpebræ superioris* functions freely, though slight ptosis is visible, due to some residual swelling of the upper lid. A 10° divergent strabismus is present, but the general movements of the globe are only slightly restricted.

There is no proptosis. The cornea is anæsthetic and the scar is nebulous and difficult to see. The pupil reacts faintly to light, but consensually the action is brisk, so the two pupils are equal under ordinary conditions. The vision of the left eye is perception of light only, the nerve head being atrophic and white. The right eye is normal in all respects.

I believe that the drainage of the sinus in this case was an essential adjunct to the chemotherapeutic measures used in securing the recovery of the patient, and that the procedure is indicated in desperate cases of cavernous sinus thrombosis.

A PRELIMINARY NOTE ON A STUDY OF POST-OPERATIVE THROMBOSIS, WITH SPECIAL REFERENCE TO A PRE-THROMBOTIC STATE.[1]

By HAROLD CUMMINE,
Gordon Craig Fellow in Urology, Royal Prince Alfred Hospital, Sydney.

THE problem of post-operative thrombosis in peripheral veins, with its dreaded complication, pulmonary infarction, has long been of interest and concern to surgeons. Over the last decade, following the discovery of the anticoagulant heparin by Howell, and the synthesis of its ally dicumoral, a growing volume of work on the prevention and treatment of the condition has appeared in the literature. There is little doubt that the administration of anticoagulants combined with surgical occlusion of involved vessels in selected cases produces very excellent results when the lesions have presented at symptom level. Inquiry now is directed to the establishment of adequate criteria for diagnosis in the earliest stages of the disease process, and if possible before symptoms present themselves. Prophylactic measures range from indiscriminate use of anticoagulants in all post-operative cases to elaborate diagnostic procedures such as venography. All are agreed that a careful study of the patient's history for familial incidence, previous personal attacks and the presence of varicose veins sounds a warning note. The type of operation and duration of anæsthesia may further awake suspicion in the surgeon's mind. Operations on the lower limbs and the peritoneal cavity are especially prone to predispose to the complication. Likewise a long, deep period of anæsthesia and strict post-operative immobilization, especially with the legs flexed by "donkeys" or over pillows, serves to increase liability to this disorder. A rising pulse rate or one maintained at a level higher than can reasonably be expected after surgical procedures is a most suspicious sign. The same may be said of an otherwise unexplained temperature chart. At times the patient will complain of vague discomfort or pain in the calves or thighs for some time prior to the onset of thrombosis. These facts have been appreciated for many years.

Bergquist[1] made a notable advance when he suggested that a "pre-thrombotic" state may exist for some hours before the onset of any other sign or symptom. He claimed that a characteristic of this state was a coagulation time in the order of three minutes. Adequate post-operative graphing of coagulation times will serve to detect this condition. If heparin is administered as soon as the prethrombotic state is determined, one, two or at the most three injections only are required to avert a thrombosis.

In the department of urology at the Royal Prince Alfred Hospital, Sydney, work has been carried out to investigate these claims. Some eighty patients undergoing major surgical operations have been carefully followed with regular coagulation times and a post-operative graph compiled in each case. The investigation is not yet complete, but at this stage it can be said that the work largely substantiates Bergquist's claims.

[1] Accepted for publication on September 5, 1946.

In a total of seven cases thrombotic incidents have occurred. In all the "prethrombotic" period was quite distinct. The cases are listed as follows:

CASE I. Coagulation time remained just over three minutes for twenty-four hours after being at five minutes for several days. Pain and stiffness in the left calf and thigh developed at the end of this period. There was marked tenderness over the upper portion of the femoral vein and a positive Homan's sign was present in the affected leg. Two intravenous injections of heparin through the day served to restore the coagulation time graph to its "normal" level. Local signs disappeared and the elevated pulse and temperature fell to normal.

CASE II. Coagulation times before operation were in the order of seven minutes. A steady daily fall occurred after operation and on the fourth post-operative day times remained at three and a half minutes for twenty-four hours. Acute pain behind the right nipple, limiting respiration, occurred, and on the following day a friction rub was present. For the next twenty-four hours the coagulation times remained at three minutes. Twenty thousand units of heparin given intravenously relieved symptoms and the coagulation times rose to levels between five and eleven minutes for the rest of the period of the patient's stay in hospital.

CASE III. Coagulation time prior to operation and for the subsequent five days was between six and four minutes. Then a fall to three and then to two and a half minutes over twelve hours occurred. Pain and mild pleurisy (without pain) developed at the base of the left lung. Twenty-five thousand units of heparin administered over three days restored the times to normal levels. Some infection of the devitalized lung area occurred which responded to penicillin.

CASE IV. In this case the patient was very ill with acute cystitis, bladder-neck obstruction and multiple bladder stones. After operation his coagulation times remained consistently below three minutes. On the ninth post-operative day, on getting out of bed, he developed an acute left pulmonary thrombosis. The same patient was readmitted for second-stage prostatectomy several months later. He was in excellent shape and his coagulation times remained above three minutes except for a brief fall to two and a half minutes on getting up. A normal level was reached in a few hours with no special therapy. His subsequent course was uneventful.

CASE V. The coagulation time varied between eight and five minutes pre-operatively and post-operatively and then at the end of the third week suddenly fell to four, to three, to two and a half minutes over sixteen hours. An acute pain with respiratory distress occurred at this stage behind the right nipple. A positive Homan's sign was present in the left calf. The pulse and temperature were elevated. Over four days 98,000 units of heparin were administered and all symptoms and signs disappeared. The coagulation time on the fifth day was seven minutes and remained at this level for several weeks.

CASE VI. The coagulation time varied between seven minutes and five minutes for three weeks and then fell to four, to three and a half, to three, to two and a half minutes over four days, when acute right pulmonary thrombosis developed. The pulse and temperature rose steadily over the four days. Thirty thousand units of heparin were administered and all symptoms disappeared. The pulse and temperature fell to normal. After heparinization the coagulation time rose to seven minutes and remained at that level until the patient's discharge from hospital.

CASE VII. The patient developed four severe pulmonary thromboses. On each occasion the coagulation times fell appreciably. Before operation and the first incident his coagulation time was seven minutes. He was followed up after discharge and similar readings were constantly obtained.

CASE VIII. This patient had had two previous thrombotic incidents (one in the leg, one in the pelvic veins) following two operations. Her pre-operative coagulation time was six minutes. This continued for the first seven post-operative days. Then an abrupt fall to three minutes occurred. This was still the level next day. Twenty thousand units of heparin were given and the graph returned to normal levels. No symptoms were present, but it appears that this was a classical example of Bergquist's "prethrombotic" state.

It is stressed that three minutes is not an abnormal level *per se*, but if maintained in the course of a post-operative graphing which habitually remains at a higher level, may well indicate Bergquist's "prethrombotic" state. It has been our experience that such a level as three minutes may occur, but when repeated in several hours has risen to higher levels. This has no pathological significance.

Our work at this stage appears to substantiate the claims of Bergquist, except that in our experience in this country the danger level may well be four rather than three minutes. A further report of the investigation will be published later.

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(1) G. Bergquist: *"Uber post-operative Thrombosen"*, *Acta Chirurgica Scandinavica*, Volume lxxxiii, 1940, page 415, abstracted in THE AUSTRALIAN AND NEW ZEALAND JOURNAL OF SURGERY, Volume xii, October, 1942, page 115.

INTRATHORACIC NEUROGENIC NEOPLASMS, WITH A REPORT OF FOUR CASES.[1]

By M. P. Susman,
Sydney.

Neoplasms arising from nervous tissue are the commonest tumours of the posterior mediastinum. They grow from the sympathetic system, an intercostal nerve or, rarely, from the vagus nerve, and originate from Schwann cells, connective tissue cells or true nervous tissue. Their biological nature varies widely, some remaining innocent throughout, while others early show their malignancy. All of them should be removed, not only because of the risk of present or future malignancy, but because many of the innocent growths may become very large in time.

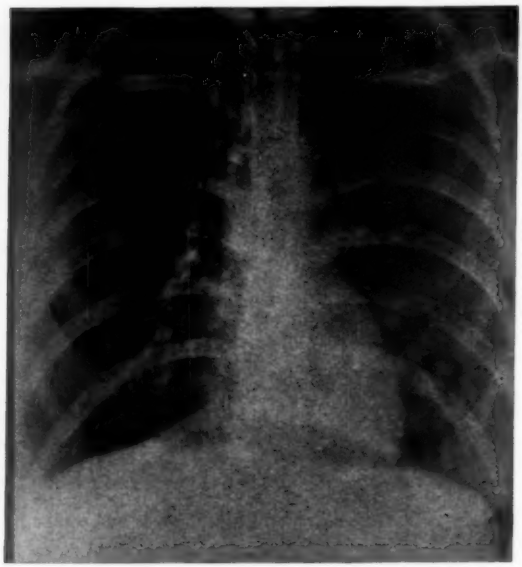

Figure I. Skiagram showing opacity at the level of the posterior end of the seventh rib and the sixth and seventh intercostal spaces.

The symptoms and signs vary with the size, site and biology of the growth; there may be none at all and the tumour may be found by chance or by routine X-ray examination. There may be general symptoms from the mere size of the growth, such as dyspnœa, irritative cough or asthmatoid attacks, or localizing symptoms, such as pain along the course of an intercostal nerve, or Horner's syndrome. The growth may extend through an intervertebral foramen and cause paraplegia, as in Case II. According to the size of the growth the signs will vary from none to an area of dulness and absent breath sounds. There may be a pleural effusion, with a growth that is still innocent.

The radiological picture, if there is no pleural effusion, is one of a well-defined, non-pulsatile shadow in the posterior part of the thorax blending with the mediastinal opacity; if erosion of the ribs or vertebræ is present, a film taken with the Potter-Bucky diaphragm will show it. A skiagram after induction of a satisfactory pneumothorax will show that the shadow is outside the lung and thus differentiate it from a pulmonary lesion such as a hydatid cyst. A good view of the tumour may be had with the thoracoscope, as in

[1] Accepted for publication on October 4, 1946.

Cases I, III and IV; it shows as a round, glistening swelling, with a smooth surface.

In April, 1944, Edward Kent and colleagues[1] reviewed the 105 cases recorded up till then and added 18 of their own. Of the total number of tumours 37% were malignant.

Some surgeons have experienced operative difficulties from large blood vessels around or in the tumour or from dense adhesions between the tumour and adjacent ribs and vertebrae. No such troubles were encountered in the four additional cases that I have to report.

CASE I.

S.M. had complained of pain near the angle of the right scapula for eighteen months, with weight loss of fourteen pounds. For several years she had been troubled by palpitation and an irritative cough. The pain was intermittent and variable, tending to be worse during menstruation. There were no abnormal physical signs and all pathological tests gave negative results. Skiagrams showed an opacity situated posteromedially at the level of the angle of the seventh right rib and the intercostal spaces above and below (Figure I). A good pneumothorax was induced and I then had, through the thoracoscope, a full view of a smooth, regular tumour corresponding to the radiological opacity.

Dr. S. V. Marshall gave a nitrous oxide-cyclopropane anæsthetic and I opened the chest through the posterior half of the seventh rib bed. Through a vertical incision in the pleura covering the growth it was easy to enucleate it intact after ligating a pedicle that was adherent to the sixth intercostal space (Figure II). The main wound was closed and airtight intercostal drainage was established below it for the escape of air and later blood-stained fluid. The lung reexpanded promptly and the tube was removed on the ninth day. The patient left hospital, well, a week later.

FIGURE II. The medial aspect of the tumour. Note the pedicle.

Pathological Report.

Macroscopic Findings: The tumour measured 4·0 by 3·5 by 2·5 centimetres. Its outer surface was fairly smooth, but there were some areas in which it had evidently been adherent to the surrounding tissues. On section it was found to be composed of interlacing strands of fibrous and in some areas gelatinous tissue.

Microscopic Findings: The greater part of the tumour consists of interlacing strands of fibres in which nuclei are not apparent. Among these anuclear fibres there are others which stain more densely and have long fusiform nuclei. Palisading of

these nuclei is not apparent, but the general appearance of the fibres suggests an origin from nerve sheath.

In some areas there are moderate numbers of large ganglion cells and non-medullated nerve fibres are recognizable. It is difficult to say to what extent the ganglion cells have participated in the growth. They are well formed and appear to be mature and it is possible that they merely represent the normal anatomical cells of the ganglion in which the tumour originated. However, it is possible that they are an essential element of the tumour, which would then have to be regarded as a ganglioneuroma and not merely as a schwannoma (Figure III).

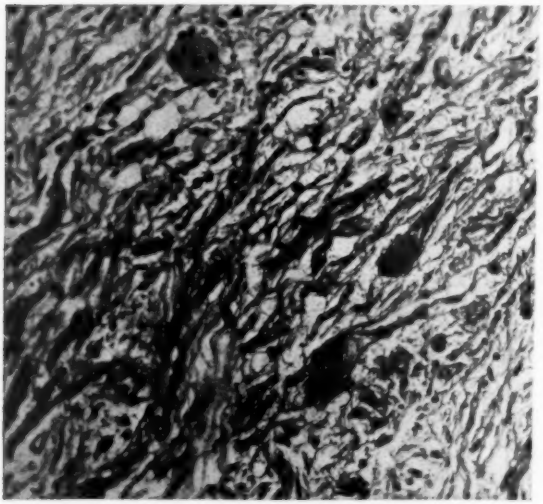

FIGURE III. Photomicrograph of a section from the main mass of the growth. (× 300.)

The small pieces of tissue described as "pedicle of the tumour" are somewhat variable in structure. One small piece is barely distinguishable from a normal sympathetic ganglion whilst in others the structure of the tumour is apparent.

There is no histological evidence of malignancy, but the ganglioneuroma is a tumour of which we know very little, and the prognosis should be guarded.

CASE II.

P.B., aged eleven years, had generalized neurofibromatosis of von Recklinghausen, confirmed by histological examination of several subcutaneous nodules. Dr. G. G. Bradley, while examining her because of pain in the lower part of the left hemithorax, found a firm, tender swelling between the ninth and tenth ribs, near their angles. Skiagrams showed an opacity in the lower half of the left side of the chest and erosion of the ninth and tenth ribs and adjacent vertebræ. (See Figures IV and V.) Her general condition was poor and she complained of constant pain at the site of the tumour, passing round to the front.

FIGURE IV. Standard chest skiagram showing opacity in the lower part of the left hemithorax.

At operation gas-cyclopropane anæsthesia was given by Dr. C. Paton. I exposed the superficial part of the tumour by turning up a flap of the skin and muscles and then resected the eroded ribs, between which the growth was bulging. The main mass of the growth was separated fairly easily from the lung and diaphragm and was removed intact. The adjacent nerves were about a centimetre in diameter, and these were removed (Figure VI). The chest was closed without drainage. A blood transfusion was given towards the end of the

operation, from which she made a slow recovery. A post-operative hæmothorax proved troublesome and I regretted not having established closed drainage at the completion of the operation.

Several months later the patient was completely paralysed below the level of the eighth thoracic segment. She was never well enough to undergo laminectomy and she died soon afterwards. At the autopsy there was gross destruction of vertebræ and ribs by tumours arising from intercostal nerves.

Pathological Report.

Macroscopic Findings: The tumour was received in three pieces, the largest of which was roughly spherical and of diameter about 9·0 centimetres. On section the peripheral portion of the tumour was seen to be white, but there was widespread necrosis in the centre and hæmorrhage had occurred in some areas. Two ribs were also received. They were very much thinned by

FIGURE V. Penetrating skiagram showing erosion of ribs.

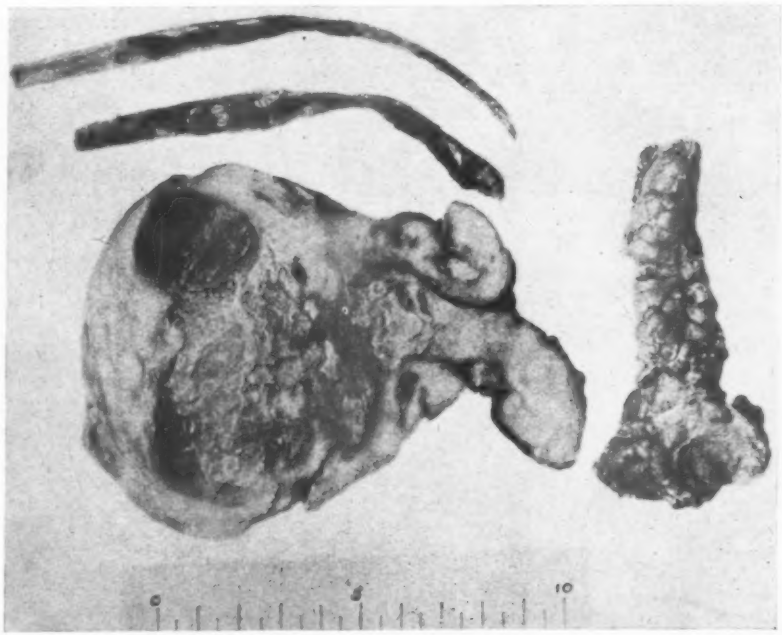

FIGURE VI. This shows the main tumour mass, sectioned to show the hæmorrhagic and breaking-down centre, part of an enlarged intercostal nerve and two eroded ribs.

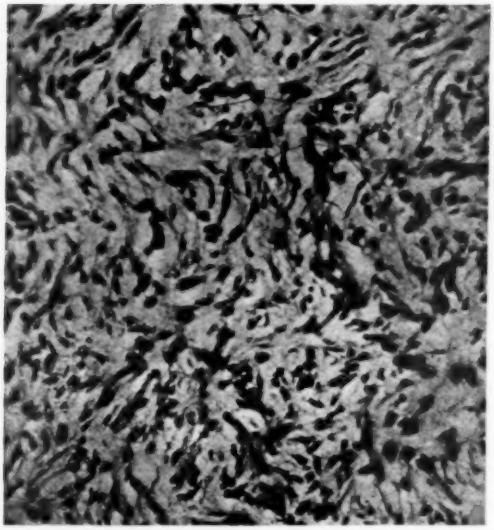

FIGURE VII. Section from main mass. (× 250.)

pressure from the tumour. There was, however, no evidence of malignant invasion of the bone (Figure VI).

Microscopic Findings: In the section made from one of the two smaller pieces of the tumour there were a number of rounded structures which on close examination were seen to be enormously hypertrophied nerves similar to those found in von Recklinghausen's disease.

Comment.

In a section made from the main mass of the tumour the structure described was not apparent, but an origin from nervous tissue would have been suspected because of the characteristics of the cells and their processes and the occasional arrangement of the nuclei in small palisades. This tumour is cellular and is apparently growing actively. The question of the grade of its malignancy cannot be dismissed easily. It is probably best regarded as a neurogenic sarcoma of low malignancy (Figure VII).

CASE III.

W.J., aged thirty-eight years, complained only of a dry cough. There were no physical signs of thoracic disease, but skiagrams showed a round homogeneous opacity, with a well-defined lower border, in the highest part of the left hemithorax; the lateral view showed that it was situated posteriorly. After induction of a pneumothorax the whole lung collapsed except the apex, which, in the skiagram now taken seemed to merge with the abnormal opacity (Figure VIII). Through the thoracoscope I had a good view of a smooth, round mass perched on the apex of the lung, around which were scattered adhesions passing to the mass and the chest wall. As the patient was suffering from malarial debility, several weeks were spent in improving his general condition.

At operation, through an incision extending from the spine of the second thoracic vertebra to the root of the scapular spine, I exposed the

FIGURE VIII. Skiagram taken after establishment of pneumothorax.

underlying ribs by splitting the trapezius and rhomboid muscles and retracting the sacro-spinalis group. Several inches of the second and third ribs were removed and the pleural cavity was opened through the bed of the third rib. With the help of rib spreaders adequate exposure was obtained and there was no difficulty in peeling the lung off the tumour, which was easily shelled out through an incision in the pleura covering it. The growth was soft and fleshy and broke up on gentle handling. During convalescence the patient had moderate fever, and a bloody effusion was aspirated twice. After this recovery was rapid.

FIGURE IX. Section of a representative portion of the growth.

Pathological Report.

Macroscopic Findings: The specimen was received in seven pieces. The largest of these took the form of an irregular plaque of tissue 4·0 centimetres in maximum diameter. One surface of the plaque was smooth and glistening; the other was covered by irregular polypoid excrescences. The other pieces of the specimen were irregularly and finely lobulated nodules of whitish, slightly translucent, coherent tissue.

Microscopic Findings: The tumour is derived from nerve sheath cells. While in most of its extent its structure is that of a benign schwannoma which has become partly fibrosed and suffered some œdematous change, there are certain characters which suggest that in spite of its clinical encapsulation it may possess some low grade of malignancy. These are the presence of occasional large aberrant cells and the occurrence of areas of necrosis of considerable extent (Figure IX).

CASE IV.

W.S., aged twenty years, said that his first symptom was sudden loss of power of the right arm, followed by pain in the back of his chest. There were no abnormal signs, but skiagrams showed a round, homogeneous, well-defined opacity in the highest and most posterior part of the right hemithorax. The skiagram taken after induction of a complete pneumothorax showed that the opacity was separate from the lung shadow (Figure X). Through the thoracoscope a smooth, regular, glistening mass was seen in the costo-vertebral gutter

FIGURE X. Skiagram after induction of pneumothorax.

At operation I made a parascapular incision, resected the fourth rib from the transverse process to the posterior axillary line and opened the pleural cavity through the rib bed. (This gave better exposure than the approach used in Case III.) The growth shelled out easily; it was uniformly white and hard like a uterine fibroid. The sympathetic trunk could be traced upwards towards the space from which the growth had been removed. The chest was closed without drainage and the patient recovered promptly after two aspirations of air and bloody fluid.

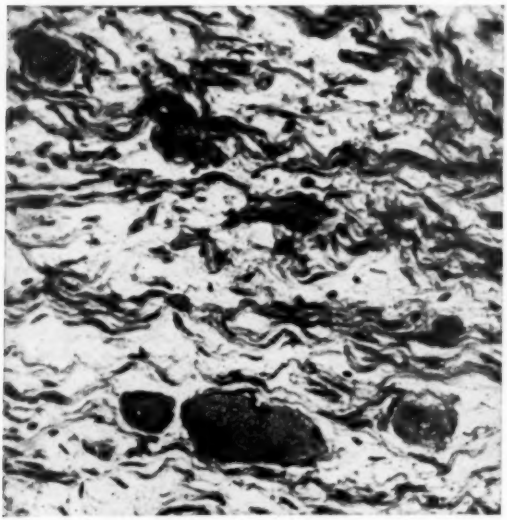

FIGURE XI. Section of the ganglioneuroma. (× 250.)

Pathological Report.

Macroscopic Findings: The specimen consisted of a portion of a tumour. It took the form of an approximately ovoid plaque 5·2 centimetres in maximum diameter and 1·5 centimetres in thickness. The constituent tissues were whitish, translucent, fairly homogeneous and of rubbery consistence. It appeared to have been encapsulated, although on one side there was a pyramidal tag of fibrous tissue 3·5 centimetres in length; at the base of this structure what appeared to be a nerve entered the tumour mass. At a distance of 3·2 centimetres away from this nerve was another structure, apparently nerve also, entering the mass.

Microscopic Findings: The tumour is a ganglioneuroma. Within the loose fibrocellular tissue are numerous ganglion cells. The majority of these cells contain only one nucleus, but a few are multinucleated. Satellite cells surround some of the ganglion cells; the others are lying in direct contact with the surrounding tissue. In the stroma there is in some fields a suspicion of palisading of the nuclei.

REFERENCE.

(1) Edward M. Kent, Brian Blades, Anibal R. Valle and E. A. Graham: "Intrathoracic Neurogenic Tumours", *The Journal of Thoracic Surgery*, Volume xiii, April, 1944, page 116.

BRONCHOSCOPY IN POST-OPERATIVE PULMONARY COMPLICATIONS.[1]

By H. B. Harwood,
Sydney.

Post-operative pulmonary complications are conditions which on occasion call for treatment by bronchoscopy. It is not suggested that a great many will need this treatment; in fact, only a few should perhaps reach this stage, but when bronchoscopy is indicated the treatment should be undertaken as a rule without much delay.

It is widely accepted today that many post-operative pulmonary complications are due to bronchial obstruction, which may cause atelectasis with absorption of the air in the isolated portion of the lung or may go on to pneumonia. The obstruction may be due to a plug of mucus, but it may also be due to a foreign body or to some lung condition, such as a tumour, which has not been previously diagnosed. In the great majority of cases some retained secretion is the cause, and this may be due to insufficient prophylactic measures having been taken. It has been suggested that sometimes spasm of the bronchial musculature during anæsthesia, by closing down the lumen on a small lump of mucus, may be the determining factor in converting a partial into a complete obstruction.

Negus has pointed out that the laryngeal and cough reflexes, ciliary action and the presence of mucus in the right quantity and of the right quality are the factors which guard the entrance and prevent infection from gaining a foothold in the lower respiratory tract, and states that the action of belladonna derivatives, sedative drugs, and anæsthetic agents, and the effects of operation sometimes overwhelm these natural defences.

When cough and laryngeal reflexes are depressed by the lowered vitality of the patient or by the action of narcotics, the respiratory tract will be more vulnerable. Also the cough reflex, although active, may be incapable of clearing the tracheo-bronchial tree. Firstly, when a patient is propped upright in bed he has to cough sputum uphill, and if the secretions are very sticky or copious he may become exhausted in his efforts without effective clearance. Also, if pain is felt at the site of his operation on deep breathing or coughing, he will tend not to try to clear any secretion away and shortly the area will become insensitive and the urge to cough will disappear.

These post-operative complications may follow the use of local anæsthesia as well as general anæsthetics; in fact the literature points to the occurrence of more cases after local anæsthesia than otherwise; but it must be remembered, of course, that an operation is often done in a "bad-risk patient" under local anæsthesia instead of under a general anæsthetic. What it comes to really is that the type of patient is more important than the type of anæsthetic in producing post-operative complications.

At times urgent operations must be undertaken, although it is recognized that the patient has some slight pulmonary condition, such as a cold or recent asthmatic attack or is a subject of chronic bronchitis; but at other times operations of election have not always been delayed for a sufficient time for these conditions to settle down into a quiescent stage and as a result post-operative complications have occurred. Some of these might have been

[1] Accepted for publication on October 15, 1946.

avoided had immediate post-operative precautions been taken. During the past few years we have at the ear, nose and throat department of the Royal Prince Alfred Hospital, Sydney, performed frequent sinus operations on bronchiectatic patients under intratracheal ether anæsthesia without any pulmonary flare-up or complication. It has been our practice to perform the operation on the day after a bronchoscopic lavage has been done and to carry out a bronchoscopic aspiration at the end of operation if thought necessary.

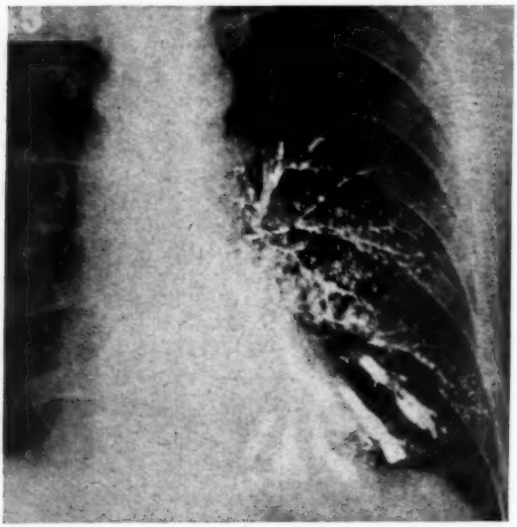

FIGURE I.

A great deal can be done by the anæsthetist to prevent these complications. He is aware of the moist condition of the patient's bronchial tree, and by suction and aspiration of the pharynx, hypopharynx and bronchial tree he may, with the institution of proper immediate after-care, be able to prevent the occurrence of any complication. Even without this, or if the complication should show up later, it will often be possible to clear the obstructive lesion and to relieve the patient without resorting to bronchoscopic aspiration.

Peronne shows figures which indicate that most of these complications follow cholecystectomy, gastro-duodenostomy and appendicectomy. He states that 71% will follow these operations. The symptoms, he finds, come on as a rule between thirty-six and forty-eight hours after operation; he gives 82% as occurring at this time, but they may come on as early as twelve hours or as late as six to ten days after operation.

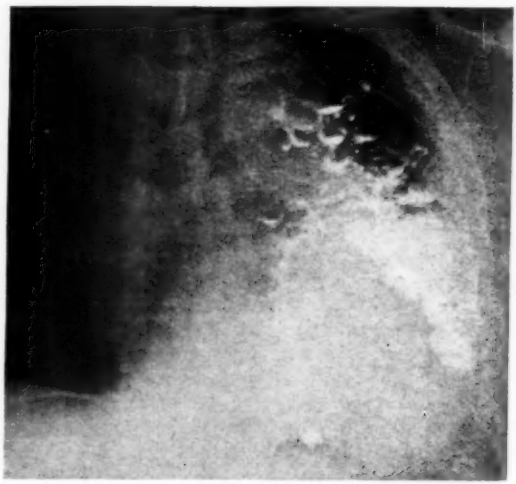

FIGURE II.

The symptoms may come on suddenly and are those of retention of bronchial secretions. A moist cough may persist after expectoration. Râles and rhonchi may appear at the bases of the lungs. There is progressive dyspnœa with a rise in temperature, pulse and respirations, and cyanosis may

be present. Sometimes there is pain in the chest. If an X-ray examination is made there may be found evidence of hypoventilation, atelectasis or bronchial pneumonia. The patient is usually too afraid of producing pain in the wound to give a sufficiently good cough to clear out the secretions.

FIGURE III.

By means of deep breathing, posturing and hand-clapping over the affected area, and movement of the patient, together with the administration of "Carbogen", most of these cases of obstruction will be cleared up. The use of a reasonable quantity of morphine to allay the pain while the patient is encouraged to cough and clear his air passages will also help; the clearing of the secretions by coughing will counteract any depressing effect of the morphine. His wound may also be supported while he is coughing.

An X-ray film, which may be taken with a portable machine, is a help in making an early diagnosis of the condition. If reluctance is felt in disturbing the patient for this procedure, it should be remembered that if the condition is one of atelectasis, the movement necessary for the taking of the skiagram will perhaps benefit him and may even relieve the obstruction. I have seen this happen on several occasions, after having been called in for bronchoscopic aspiration which was then not found necessary.

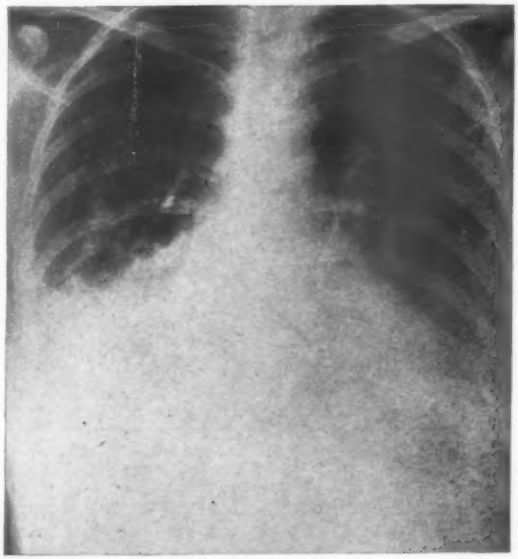

FIGURE IV.

When the simple means of relieving any obstruction as mentioned above are of no avail, then bronchoscopic aspiration should be immediately considered. The passing of a bronchoscope in skilled hands does not disturb a patient unduly. The patient need not be moved from his bed. The bed may

be taken to the theatre or, more simply, the procedure can be carried out in the ward. This should be done under local anæsthesia and even in quite young children it should not be necessary to resort to general anæsthesia as a rule. With very little disturbance of the patient a full bronchoscopic investigation may be made and any secretion which may be found can be aspirated and even some lavage may be carried out if considered advisable. The whole procedure takes only a very short time.

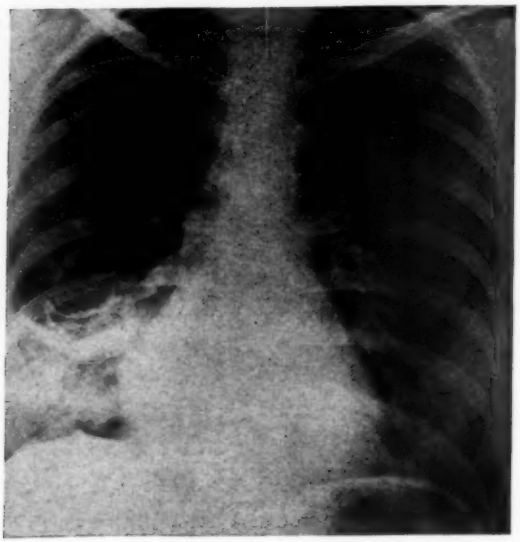

FIGURE V.

My usual practice is to carry out the bronchoscopy in the ward. Premedication, by such a drug as heroin, one-eighth of a grain, may be given half an hour before. The lips, mouth, pharynx, larynx and trachea are then sprayed with local anæsthetic solution. I use for this a mixture of 45 minims of a 2% decicain solution with 15 minims of a 1 in 1,000 solution of adrenaline. As soon as the spraying is finished the patient is ready for bronchoscopy.

The top of the bed is removed and the patient is placed in the semi-Fowler position with the head extended. If the top of the bed is not removable, the patient may lie diagonally across the bed, either to the right or left, depending upon which lung is mostly affected —for example, with the head to the right for the left lung and to the left for the right lung. The bronchoscope is then passed into the trachea and bronchi, which are examined, and any mucopus may be aspirated. If the mucopus is very sticky or if it is deeply situated, lavage with 5·0 cubic centimetres of saline solution may be used with the aspiration.

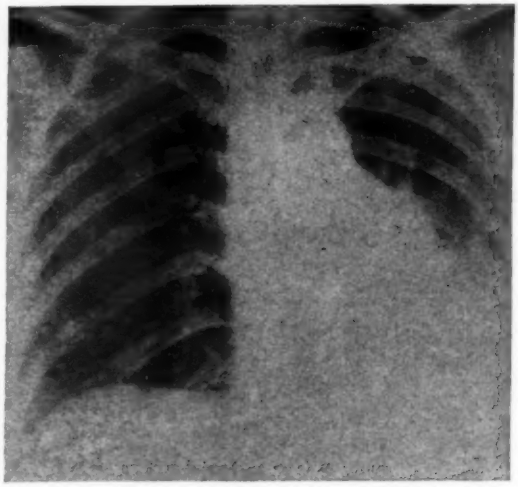

FIGURE VI.

Sometimes almost immediate relief is felt by the patient, while in other cases relief in a few hours is very noticeable. The colour, pulse and

respirations improve and the temperature falls, while the patient feels more comfortable, the tight feeling in the chest will disappear, and he will find that he is now able to cough up any sputum that is present with little difficulty.

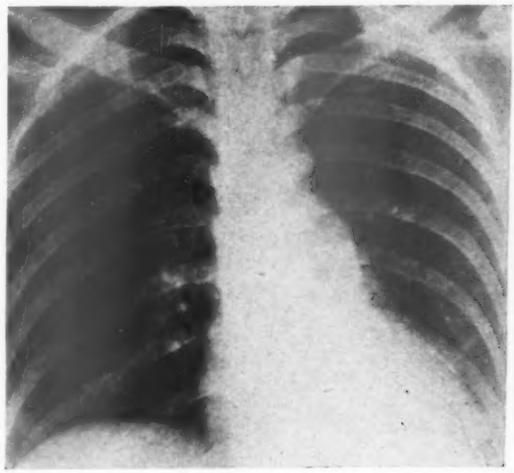

FIGURE VII.

It will very seldom be found necessary to do a further bronchoscopy in these cases if bronchoscopy is done early. If the patients are not treated as indicated above, but are allowed to drift along, there is the possibility of the development of lung abscess and bronchiectasis. We have found this to have occurred in a number of cases in which no notice of the persistent post-operative cough had been taken, even when this had continued long after post-operative pneumonia had apparently settled down. It is still possible to find the patient who states that he has come back to the surgeon after being discharged from hospital and that he has complained again and again of the continued cough with sputum, only to be told that the wound has healed nicely and no doubt he will soon be better. I have several such patients in my bronchoscopic clinic who eventually did settle down into a marked saccular bronchiectasis.

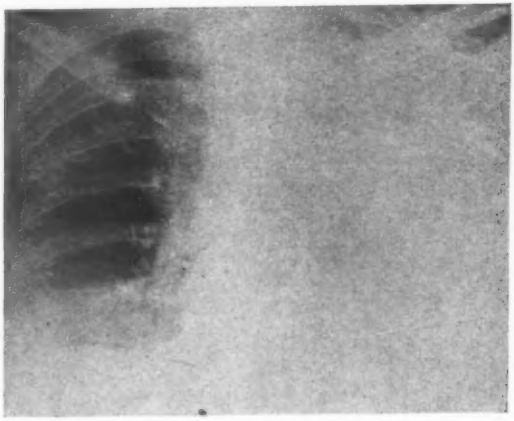

FIGURE VIII.

Such a patient is the one whose film I show in Figure I.

The patient entered hospital with no cough on February 11, 1944, and was immediately operated on for acute appendicitis. On February 23, 1944, he complained of chest symptoms, and signs were found in the base of the left lung. An X-ray examination made on February 24, 1944, revealed an area of consolidation in the base of the left lung. He went out with a cough and sputum, which remained with him. He complained at intervals until in September, 1944, another skiagram was taken, suggesting some bronchiectasis at the base of the left lung. Nothing further was done until he came to me in January, 1945, when I found a well-marked bronchiectasis at the left base. He had had hæmoptysis at intervals and was coughing up several ounces of dirty sputum daily. He was put on bronchoscopic lavage and improved greatly till last November, when he was given a parenteral and local course of penicillin. Since then his remaining sputum has ceased and only

a few flakes can be washed out. He still has, however, his marked saccular bronchiectasis, which might never have developed had earlier treatment been undertaken.

It must not be altogether forgotten that a foreign body may be the cause of a post-operative pulmonary complication. The patient whose film is shown in Figure II is one in point.

FIGURE IX.

The patient had ether anæsthesia induced by the open method for removal of a finger while abroad. Following operation he had some pulmonary complications and in course of time proceeded to go down hill rapidly. He had numerous tests and examinations done, including a Wassermann test and a Mantoux test, and innumerable X-ray films were taken. After about two years he was coughing up vast quantities of extremely foul sputum, and I first saw him at this stage. On submitting him to bronchoscopy I found a large tumour mass in the left main bronchus. This was removed and a good deal of granulation tissue was found to be still present in the bronchus. As this was gradually cleared up and the bronchus dilated, a piece of rubber tube was found to be present in the bronchus. This had obviously been lost from the jaws of a mouth gag during the operation on his finger. Following removal of the rubber tube, and with repeated washouts, he improved rapidly and he put on three stone nine pounds in weight, while the sputum has practically ceased. He has, however, been left with a dreadful lesion of the left lung. Removal has been suggested to him, but at present he prefers to go along as he is.

FIGURE X.

Had a bronchoscopic examination been made early in the post-operative sickness, his left lung, in all probability, would have been useful today.

I will now discuss four other cases in which bronchoscopic aspiration was done soon after the symptoms appeared, and will show some of the X-ray films.

The first case is that of a girl of nine years of age, who was admitted to hospital on February 2, 1946, having slipped on a fence and spiked her abdominal wall rather badly, requiring immediate operation. Next day her temperature and respirations and pulse rate rose and she had a troublesome cough with yellow sputum. She was given sulphonamides and later penicillin. She was more distressed next day and she had signs at the base of the right lung. That evening, at 5.30 o'clock, I examined her with the bronchoscope and aspirated a large mass of very sticky mucopus from the lower right main bronchus. At that time her respirations numbered 43 per minute,

her pulse rate was 140 and her temperature 101° F. At 8 p.m. she was much more comfortable, her cough was less troublesome and her respiratory rate was lowered. Next morning the air entry to the base of the right lung was much improved and the respirations had dropped to 30, the pulse rate was 118 and her temperature was 98·4° F. The temperature did, however, go up slightly for a few days, but the pulse and respiration rates quickly returned to normal. Follow-up skiagrams were not taken of this patient.

FIGURE XI.

The next patient is aged twenty-nine years. She was operated on on April 23, 1946, when a thyreoidectomy was done. Previous to this it was noted that her chest was clear. At 11 o'clock that night she was restless and sweating, her pulse rate was 170, and her temperature was 103° F. She developed respiratory embarrassment, and on April 25 showed clinical signs of atelectasis of the right lung. She was having difficulty in coughing and was put on penicillin. Next day her temperature was 100·4° F. and her pulse rate 108, but she was still very distressed, and the following morning I was called in to carry out bronchoscopy. There had been little response in her general condition to the penicillin treatment. I aspirated some very sticky mucopus from the right main bronchus and there was almost instant relief. Next day there was no respiratory distress and she went home eight days after the bronchoscopy. Figures III, IV and V will show the course of the condition. The first skiagram (Figure III) was taken on the day before she was submitted to bronchoscopy and shows some considerable dulness of the base of the right lung. The next one (Figure IV), taken three days after bronchoscopy, shows that the condition had improved, but that some changes were still present. A further skiagram (Figure V), taken one week later, shows more improvement, which was even more pronounced in a slightly later skiagram.

FIGURE XII.

The next case is that of a girl, aged twenty years, who came to hospital and had an urgent appendicectomy performed on May 4, 1946. On May 7 she had wheezing and

her temperature went up to 100° F. Next day she was coughing up thick, purulent sputum and her temperature was still up, so she was put on sulphonamides. The first skiagram (Figure VI) was taken on May 8, 1946, and shows a definite opacity involving the left lower lung fields with some displacement of the cardiac shadow. Following this I was asked to perform bronchoscopy that night. I obtained some very sticky mucopus from the left main bronchus and from the lesser bronchi. She was very much relieved shortly afterwards, and next morning was breathing with greater comfort, and her temperature was down to 99° F. Pulse rate and respirations came down within twenty-four hours. From then on she was able to cough up her sputum more easily and she was discharged from hospital seven days after bronchoscopy. She also had been on penicillin for twenty-four hours prior to bronchoscopic aspiration without any relief of the chest symptoms. The next skiagram (Figure VII), taken three days later, shows that improvement had taken place, and later skiagrams showed progressive clearing up of the condition.

The next patient was one who had cholecystectomy done on June 6, 1946. Her temperature went up to 101° F. and she developed a cough with much discomfort in breathing. A skiagram (Figure VIII) was taken on June 11, 1946, at 3 o'clock p.m., showing dulness over the whole of the left lung field. I performed bronchoscopy two hours later, at 5 o'clock p.m., and aspirated a moderate amount of extremely sticky mucopus from the left side. She felt very much more comfortable in fifteen to twenty minutes; she was able to breathe more easily and her temperature came down to 98·4° F. by next morning and remained there. A skiagram (Figure IX), taken the following morning at 10 o'clock, shows a clearing up of the upper portion of the lung field, and another skiagram (Figure X), taken the following morning, shows an even clearer picture.

While it must be admitted that in some of the cases of this type the condition will eventually settle down without leaving any marked after-effects, if bronchoscopy is not performed, still with it the condition will settle more quickly, the patients will feel comfortable almost immediately, and their stay in hospital will probably be shortened.

Finally I shall show two more films to demonstrate that even if the above treatment is delayed and the patient develops some pneumonic condition with delayed resolution, there is still some hope, in some cases, if early treatment is instituted, of preventing the condition becoming permanent as it did in the first case mentioned today.

This patient had had bronchiectasis for many years on the left side. At about the time her child was born she developed pneumonia and I saw her some eight to ten weeks later. A lipiodol X-ray examination was made in the course of investigation and the condition shown in the film (Figure XI) was found. It shows bronchiectasis on the left side, with well-dilated saccular bronchi on the right side. The patient had bronchoscopic aspiration and lavage, and the condition of the right lung, the recent infection, cleared up, while the old-standing bronchiectasis of the left base remained unaltered. There is a series of skiagrams showing the gradual clearing up of the base of the right lung, but I shall just show the most recent one taken (Figure XII), presenting a clear right lung field and a saccular bronchiectasis of the base of the left lung, which shows no alteration from the first film.

I should like to finish by emphasizing the fact that some post-operative pulmonary complications will not clear up without bronchoscopic aspiration, though most of them will with the usual simple methods of treatment, if they are used. If bronchoscopic treatment is to be used, it must be used early; and if it is not availed of, the patients may settle down to a certain degree of invalidism, a condition which need not have occurred.

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Case Reports.

CYSTECTOMY.[1]

By KEITH KIRKLAND,
Sydney.

MALIGNANT DISEASE of the bladder, unless diagnosed early, when the lesion is small and total removal or local destruction possible, creates major problems in treatment and often is the cause of extreme misery during the final months of the patient's life. Total cystectomy after transplantation of the ureters in selected cases is the indicated procedure. I wish to report three cases in which this has been done.

The first patient, Mr. J.O'N., was seen in 1940 with a papillary carcinoma of the left half of the bladder. After transplanting both ureters on separate occasions I performed total cystectomy in August, 1940. The patient, who was then fifty-seven years of age, is today fit and well after nearly six years. His bowel control is such that most nights he does not have to get up to evacute the rectum.

The bladder, prostate and vesicles were removed in one mass. On splitting the bladder a large papillary carcinoma was present on the left wall. This case was reported in *The Medical Journal of Australia* of June 7, 1941, in a paper on vesical exclusion.

The second patient, Mr. McN., aged forty-seven years, was admitted to the Mater Misericordiæ Hospital in January this year with a history of frequency of micturition and hæmaturia. Cystoscopy revealed a sessile tumour of the bladder base, involving the right ureteral orifice. The excretion urogram showed that, although both kidneys functioned well, the lower part of the right ureter was dilated owing to partial obstruction. I transplanted the right ureter to the bowel on February 1, 1946, and the left on February 15, 1946, and carried out cystectomy on March 23, 1946, and the patient's progress since then has been uneventful. He, too, has good bowel control, with a discrimination between solid and fluid contents, and gets up at night only if he has taken too much fluid during the evening. I was helped considerably in the after-care of Mr. McN. by the nursing and resident staff of the Mater Misericordiæ Hospital, also by my assistant, Dr. E. Maloney.

The excretion urogram taken after the series of operations had been completed showed both kidneys to be functioning well, with no evidence of obstruction.

The third case is that of Mr. M., aged fifty-seven years. I mention him by courtesy of Dr. A. L. Carrodus, who has done most of the work. He was admitted to hospital on February 19, 1946, with a history of painless hæmaturia of some months' duration. Cystoscopy revealed a large papillomatous mass at the base of the bladder, which was palpable bimanually above the prostate gland. The ureters were transplanted on March 13, 1946, and April 10, 1946. Cystectomy was performed on May 8, 1946. Healing of the wound was delayed by a *Bacillus proteus* infection. Actually doubt exists whether the primary growth was in the bladder, vesicle or prostate. The specimen showed considerable infiltration of these three organs and there is no characteristic arrangement of the carcinoma cells. The prognosis must be regarded as unfavourable.

Indications.

As cystectomy is performed most often for malignant disease, it is impossible to standardize the indications or to define absolutely the contraindications. As a general rule it may be said that the operation is indicated when it is believed that total extirpation of the growth is a reasonable possibility and that cure of the condition is impossible by other means. I do not believe that operation is justified as a palliative measure. From the point of view of local indications, the nature and situation of the neoplasm may be deciding factors.

Malignant growths whose destruction or removal would lead to gross loss of bladder function, and growths situated about the bladder base whose destruction would involve the ureteral orifice, come under this heading.

[1] Accepted for publication on October 4, 1946.

Operability.

When removal of the bladder has been suggested as the most suitable form of treatment every effort must be made to assess operability. Cystoscopy should be performed under general or spinal anæsthesia, as the extent of the growth can be better seen by a deliberate and unhurried examination. Rectal, vaginal and bimanual examinations to estimate the size of the growth, its infiltration of the bladder, the fixity or otherwise of that organ, and the involvement possible of adjoining organs must be carried out. Assessment of the growth only by the view revealed at cystoscopy may be misleading, as an apparently small and visible growth may be the surface manifestation of an extensive, infiltrating and inoperable condition.

At operation for diversion of the urinary stream a detailed examination of the bladder must be made from the peritoneal aspect. The iliac chain of glands should be palpated, and generally an inspection made to exclude metastases in the paraaortic glands.

An excretion urogram must be carried out in every case to evaluate renal function. Marked loss of function due to involvement of the bladder base with consequent obstruction may preclude any surgical approach. A full blood examination and count is a routine procedure. The blood should be typed and facilities for transfusion should be available in case the need should arise.

One general contraindication is, of course, age and general fitness of the patient to face two or three major surgical procedures. Very careful evaluation of the patient over sixty years of age is necessary.

Operation.

In most cases the ureters will have to be transplanted to the skin or bowel as a preliminary to removal of the bladder. Immediately prior to operation a rectal tube should be passed and this should not be removed until the operation is completed, as an empty lower bowel is an advantage.

The bladder is exposed by a suprapubic incision with the patient in a partial Trendelenburg position. The recti muscles are separated and retracted. The dome of the bladder should be freed from the closely adherent peritoneum, unless the growth is in this situation, when the adjoining segments of the peritoneum should be removed. By careful dissection backwards the bladder may be freed down to its relationship to the rectum. Lateral freeing provides no particular difficulties until one reaches the stumps of the ureters, where the inferior vesical arteries will be encountered. It is, I think, a good plan to tie off all vessels when they are divided.

The next step is freeing of the bladder neck, in the cave of Retzius, by blunt dissection. It is then possible to encircle by the fingers the posterior part of the urethra, which is divided beyond the prostate in the male and about the middle in the female. Traction is then applied to the proximal end, and by gauze dissection the prostate and bladder neck in the male may be lifted out of their bed.

There is a distinct plane of cleavage between the bladder base and rectum, so that separation is easily achieved back to the area originally freed. The bladder mass should then be attached only on each side lateral to the seminal vesicles. At these points the dissection should be carefully done, as irregular vessels enter and leave the bladder.

I make a practice of putting sulphanilamide powder into the cavity thus created and lightly packing with wide gauze. Soft rubber tubes will provide a satisfactory drainage.

I believe the whole operation is best done by the suprapubic approach without there being any need for the combined suprapubic and perineal technique.

I remove the gauze forty-eight hours after the operation and the tubes at the same time, depending on the amount of serosanguineous drainage.

Summary.

1. Three cases of carcinoma of the bladder in which total cystectomy was performed are described.
2. As a preliminary in each case the ureters were transplanted to the sigmoid.
3. The indications for this measure are briefly discussed.
4. The operation of cystectomy is described.

Post-Scriptum.

More recently I have had occasion to perform the operation on two other patients and I report them as I think they represent an improvement in technique.

J.K., aged fifty-five years, was admitted to Saint Vincent's General Hospital on October 7, 1946, with a history of hæmaturia of three weeks' duration. At cystoscopy he was seen to have a carcinoma involving the left lateral wall, and partial cystectomy

was proposed. On October 16, 1946, I mobilized the upper part of the bladder with a view to removing the segment of bladder involved. On opening the bladder the growth was found to involve the base and cystectomy was decided upon. The right and left ureters were transplanted, and the bladder, prostate and vesicles removed at the one operation. The time occupied for operation was one hour and forty-five minutes. The patient is making an uneventful recovery.

The fifth patient, G.N., aged fifty-one years, was found to have a large exuberant cancer of the left wall and base of the bladder. On October 8, 1946, I transplanted the right ureter into the bowel. Encouraged by the success of the one-stage operation on the patient mentioned above, on October 29, 1946, I transplanted the left ureter and performed total cystectomy, the time of operation being one hour forty minutes. His condition has caused no worry since the operation.

I feel that wherever possible the ideal is to transplant both ureters and remove the bladder by one operation. Despite one's conclusions following the other examinations already enumerated, it is only by full and free exposure of the bladder that operability can be assessed. By making this examination at the beginning of the operation the risk of submitting the patient to bilateral ureteral transplantation when the bladder condition is inoperable is reduced to a minimum. By paying particular attention to certain features of the operative technique it should be possible to do the total operation in one and a half hours.

In each of the two last cases blood transfusion was started soon after the beginning of the operation and undoubtedly was an important factor in the well-being of the patient at the finish of the operation.

A CASE OF PROLAPSED INTERVERTEBRAL DISK, WITH ANTE-MORTEM AND POST-MORTEM FINDINGS.[1]

By DONALD MCKENZIE,
Auckland.

DESPITE the voluminous literature on the prolapsed intervertebral disk, there appears to be only one case published of detailed post-mortem study of the sciatic nerve in which the clinical condition had also been studied prior to death. In that instance, however, no examination of the intraspinal roots or spine was possible (Denny-Brown, 1933.) Denny-Brown refers to four prior instances published from 1775 to 1905, though none of them is very convincing. The following case is worthy of record in that a complete examination of the spine and nerve roots was possible.

FIGURE I.

Clinical History.

A man of thirty-four years of age, with no antecedent history of injury, developed "lumbago" in July, 1944, and this was quickly followed by sciatic pain radiating to the ankle. On October 6 it was recorded *inter alia* that the knee jerk and ankle jerk were absent and that the protein content of the spinal fluid was 60 milligrammes *per centum*. A diagnosis of prolapsed intervertebral disk was made and the patient was treated by two months' rest on a Bradford frame.

FIGURE II.

I had occasion to examine him on March 27, 1945, nine months after the onset, when he had no complaint of sciatic pain and walked without a limp. The spine was slightly flattened in the lumbar region and he could bend forwards so that he was almost able to touch his toes. The signs in the right leg were as follows. He had

[1] Accepted for publication on September 5, 1946.

weakness of the anterior tibial extensor muscles, and half an inch of wasting was revealed by the circumference of the calf. The knee jerk and the ankle jerk were markedly diminished as compared with the other extremity. There was hypæsthesia to pin prick over the outer half of the foot. Vibration sense was completely lost in the first and fifth toes, and the position sense was diminished in the fifth toe.

He exhibited the usual signs of root compression, but the pain had subsided. He was anxious to return to work as a driver, and was advised to do so.

Whilst dressing after the examination he suffered a coronary attack and fell dead at our feet.

FIGURE III.

Post-Mortem Findings.

The lumbo-sacral spine was fixed in formalin and then sectioned in the sagittal plane (Figure I). The fifth *nucleus pulposus* is seen to be flat on section as opposed to the normal disks above, which have bulged out to 5·0 millimetres above the cut surface.

The more detailed picture of the posterior parts of the disks (Figure II) shows the laminæ of the upper normal disk to be intact and the tissue under the posterior common ligament to be in thin orderly layers. The lower affected disk shows the annulus to be ruptured, with extruded, disorderly tissue beneath the posterior common ligament, which is itself thickened.

As the protrusion was more lateral it does not show markedly in the mid-line section, nor does the constriction of the thecal sheath show in the photograph. Nevertheless on the right side the nerve root fills the orifice, whereas forceps could be inserted alongside the root in the other sheaths.

The affected root at post-mortem examination presented no naked-eye changes from the other roots. All appeared to be the normal glistening white colour with no arachnoidal engorgement or thickening. This appearance is stated accurately, because in various surgical reports of thickened "roots" the descriptions really deal with the thecal sheath. The sciatic nerve trunks also showed no naked-eye change.

X-ray pictures of the half-spine reveal no suggestive sign of disk prolapse (Figure III). They do show a false joint at the

FIGURE IV. Right first sacral root showing distended interfascicular spaces.

junction of the lamina and pedicle of the fifth lumbar vertebra, and one wonders if this prerequisite of spondylolisthesis may not throw extra strain on this particular disk.

Histological Appearances.

I am indebted to Professor W. Adams, of the anatomy department of the Otago Medical School, for the following report on the histological appearances of the affected root and normal controls.

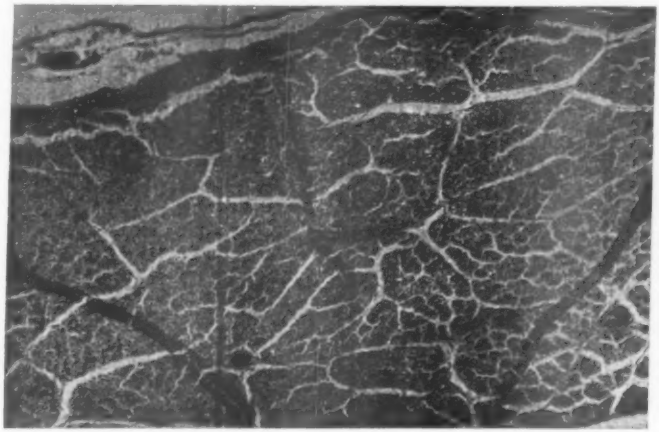

FIGURE V. Left first sacral root. Normal compact structure.

The specimen submitted was the entire lumbo-sacral column and *cauda equina*, which had been previously fixed in formalin. The fixation was inadequate and considerable shrinkage had resulted, but impregnation of the axis cylinders by the protargol-silver method of Bodian (1936) was satisfactory enough to permit certain observations. Attempts to stain the myelin sheaths were unavailing.

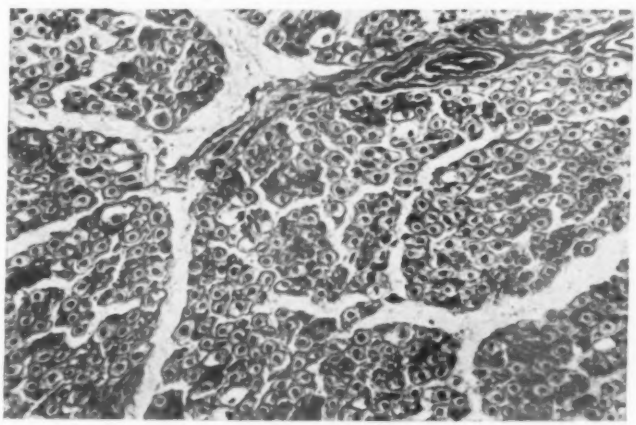

FIGURE VI. Left first sacral root. Normal appearance of non-medullated fibres and medullated fibres of varying myelination.

Here the root involved was the right first sacral. A short section of this root, approximately at the level of the supposed compression, had previously been removed. There remained for study, therefore, a central stump which, just proximal to its cut end, presented a moderate bulbous swelling, and a peripheral stump—the first sacral

nerve in the first sacral foramen. Both were examined and contrasted with the opposite (left) first sacral nerve, which histological examination showed to be unaffected. The following observations were made.

1. The central stump in the region of the swelling showed a marked separation of fasciculi with some widening of the endoneural spaces (Figure IV), a feature closely

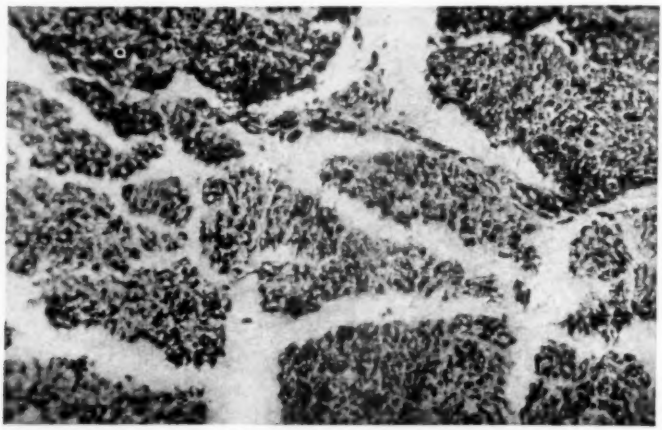

FIGURE VII. Right first sacral root. Separation of fasciculi. Denser packing of nerve fibres with great reduction in myelination.

resembling the findings of Weiss (1943) and Denny-Brown and Brenner (1944) in the zone just central to a localized constriction of a peripheral nerve. It is Weiss's view that such œdema results from the damming up of peripherally flowing endoneural fluid. A comparison with the opposite root, which appeared to be quite normal (Figure V)

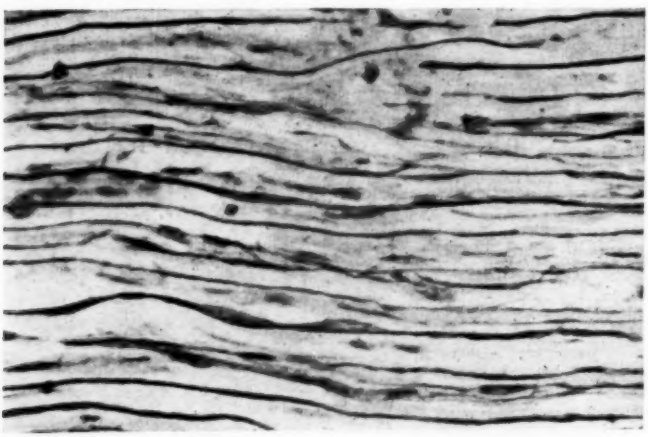

FIGURE VIII. Left first sacral root. Normal architecture with regularity of axones and normal myelin sheaths. (Axones show marked fixation defects including reduction in calibre.) High power.

suggested that these changes in the affected root were possibly due to œdema just central to a localized compression or constriction of the root.

2. In both the central and peripheral stumps the axis cylinders were intact. There was thus no obvious Wallerian degeneration in the affected nerve. Nevertheless certain changes were noticeable, involving both the myelin sheaths and axis cylinders.

In comparison with the normal root (Figure VI) the central stump of the affected root (Figure VII) showed a great preponderance of lightly medullated fibres with axis cylinders of smaller calibre and a marked absence of the typical heavily medullated fibres of the control root. Hence an immediate impression of closer packing and greater

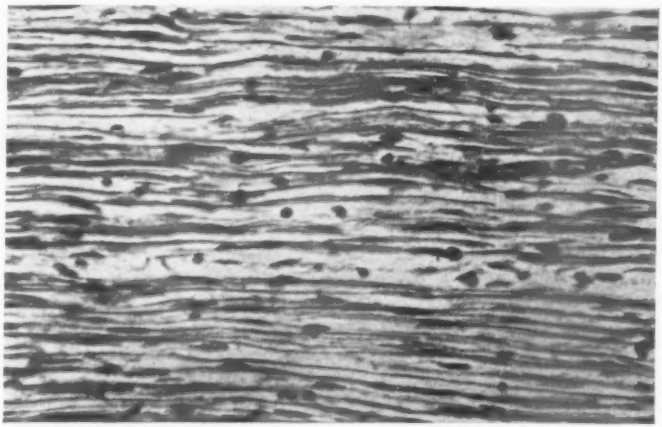

FIGURE IX. Right first sacral root. Note the greater density of axis cylinders due to their reduced diameter and particularly reduction in myelin sheaths. Slight increase in cell population. Occasional lymphocytes present. Same magnification as Figure VIII.

density of axis cylinders (contrast Figures VIII and IX at same magnification). This was most obvious in the "œdematous" zone, and the interpretation of the finding is difficult, for, far from resembling the changes observed by Weiss (1943) in the œdematous zone of a constricted nerve, the observations paralleled closely those observed

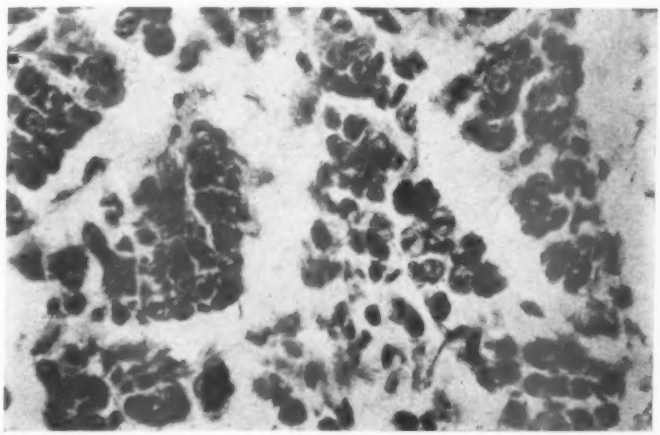

FIGURE X. Right first sacral nerve (distal stump). Representative section showing preservation of axis cylinders and myelin sheaths. No Wallerian degeneration apparent.

in the constricted zone itself (Weiss, 1943, Figure IV, C), and suggested that the fibres might have been compressed possibly by the œdema. However, the absence of any degeneration in the peripheral stump (Figure X) indicated that if the changes were the result of compression it could not have been as great as that in Weiss's

experiment. It is clear that the interpretation of the findings in this case suffers from our inadequate understanding of the effects of compression of varying degrees on nerve trunks.

3. An examination of the cellular elements of both the central and peripheral stumps makes it clear that there was in this case no marked inflammatory reaction or lymphoid infiltration in the affected nerve (Figure IX). Occasional lymphocytes could be observed in a perivascular situation, in the interfascicular tissue, but there was no infiltration of the fasciculi themselves. There was, however, a slight cellular increase in the central stump of the affected root when it was compared with the normal. This was due partly to an increase in Schwann nuclei which might have been the result of the denser packing of the nerve fibres, rather than an absolute increase in numbers, and partly to a moderate increase in fibroblasts and macrophages. Such changes have been recorded by Weiss (1943) in the œdematous zone of constricted nerves, and according to him lead ultimately to fibrous transformation of the peripheral part of the œdematous zone. Such fibrosis was not apparent in this case.

Summary.

A case of sciatica is described in a young man with recovery of symptoms after nine months, but with neurological signs persisting.

The naked eye appearance of the prolapsed nucleus and nerve roots is described.

The histological appearance of the affected nerve root on either side of the site of constriction is described. The central zone was œdematous ,with marked demyelination and smaller axis cylinders. The peripheral zone did not show any degenerative changes, and as the axis cylinders were intact on both sides of the constriction, there was no true Wallerian degeneration. There was no evidence of any inflammatory round-celled infiltration in any part of the root.

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PERIPHERAL TRAUMATIC ANEURYSM.[1]

By H. A. PHILLIPS,
Melbourne.

THE object of this communication is to report four cases which occurred in the Australian Imperial Force in Malaya. Two of the cases were arterio-venous aneurysms. The case histories briefly are as follow.

Case I.

Private S. sustained a small gunshot wound of the left thigh which involved the femoral artery at its entry to Hunter's canal. About three weeks later an aneurysmal swelling was noted immediately under the wound, which had not healed. A gross thrill and loud bruit were noted, extending well up to the groin. No cardiac bruits were present nor was there a definite response to Branham's test (see below), but arterio-venous communication was suggested by the magnitude and conduction of bruit and thrill. Six weeks after the time of the wounding operation was necessitated by hæmorrhage from the sac, then the size of a golf ball. The condition was found to be an arterio-venous aneurysm of the femoral artery. Excision was thought to be impracticable, so quadruple ligation was performed. On removal of the tourniquet, however, hæmorrhage still occurred from the collapsed sac. This was not controlled until a mattress suture was passed around the tissues deep to the sac.

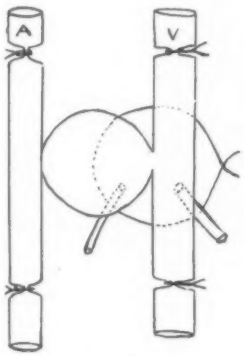

FIGURE I.

It would seem that a tributary of the femoral vein communicated with the deep surface of the sac, either by normal anatomy or by secondary fistula formation. Diagrammatically the condition and treatment were as shown in Figure I. Fourteen days after operation secondary hæmorrhage occurred, but was controlled by further sutures at the original site. For some months persistent coldness and stiffness in the toes were evidence of ischæmia, but eventually complete recovery occurred. (This patient was under the care of Major Fagan.)

Case II.

Private B. had sustained a gunshot wound of the left thigh in Scarpa's triangle. Three weeks after injury, when the wound was healed, the patient noticed a swelling at this site. This was an aneurysm similar in size to that found in Case I, but with no thrill. Operation by Major Hobbs six weeks after the date of the wounding revealed a simple aneurysm of the superficial femoral artery immediately below the bifurcation of the common femoral artery. Again tissue planes were seriously obscured by inflammatory reaction, and treatment consisted in ligature of the superficial femoral artery above and below the aneurysm, as in Figure II. An acute spreading streptococcal infection followed the operation, but was controlled by sulphonamides.

FIGURE II.

Case III.

Corporal F. sustained a gunshot wound of the right arm. Swelling appeared under the wound six weeks after the wounding—an aneurysm of the brachial artery of walnut size. It remained stationary, caused no symptoms and showed no signs of venous involvement. At operation three and a half months after wounding, Lieutenant-Colonel Osborn exposed and resected the sac. Three weeks later the circulation of the limb had almost completely recovered. (See Figure III.)

FIGURE III.

[1] Accepted for publication on October 4, 1946.

Case IV.

Private H. sustained a gunshot wound of the left popliteal fossa. Two weeks later he noticed a large swelling which proved to be an aneurysm of the popliteal artery and vein. There was a very marked thrill and bruit extending well up the thigh. Varicosities were present in the upper part of the calf. There was no tachycardia, bruit or Branham's phenomenon. A complete peroneal nerve palsy developed in the next four weeks, during which time the aneurysm doubled in size. Operation was deferred for six months to allow the maximum collateral circulation to develop and to lessen the danger of later amputation for gangrene. In two out of four previous popliteal artery and vein ligations this complication had occurred. Quadruple ligatures were applied as in Figure IV, and the peroneal nerve, which had not been damaged by the missile, was cleared of scar tissue. Dissection was much easier in this case than in Cases I and II, in which operation was performed at earlier stages. A small secondary venous hæmorrhage occurred on the fourth day and the wound was reopened and a bleeding varicosity was secured. No gangrene occurred and the nerve recovered full function during the next three months.

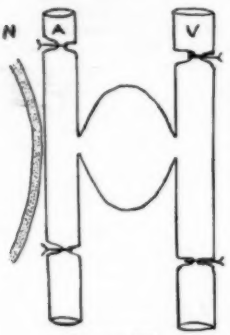

FIGURE IV.

Comment.

These four cases comprise 0·4% of the total number of men reported as wounded in the campaign. In two of the four cases there was an arterio-venous communication which was diagnosed pre-operatively by the exaggerated thrill which was conducted along six to eight inches of the vein. Branham's sign, the slowing of the pulse rate and increase in volume on obliteration of the aneurysm by pressure, was absent in these two arterio-venous aneurysms. Tortuosity of dilated skin veins was observed in one of the two cases. There was no evidence of cardiac decompensation. Generally, about three weeks elapsed before the appearance of these traumatic aneurysms. Operation was found to be more satisfactory when delayed till about three months, as by then the collateral circulation had developed and the dissection of tissue planes necessary to demonstrate the vascular components was easier.

Case II shows the danger of a streptococcal "flare-up" in the wound post-operatively. Case I shows the possibility of hæmorrhage precipitating the necessity for immediate operation, and Cases I and IV illustrate the risk of post-operative hæmorrhage. Although in no case did post-operative gangrene occur, there was an impaired circulation in the distal portion of the limb, manifested by coldness and swelling of the extremities with some loss of function of the fingers or toes. It was noticed that there was least ischæmia in the case of the popliteal aneurysm (Case IV), probably owing to the fact that this patient was left the longest time before operation (six months).

Although resection of the sac with all its vascular communications is advised, it is often easier to ligate the artery (and vein if communicating) above and below the sac (quadruple ligation). This, however, proved ineffective in Case I, in which, owing to the compound nature of the fistula, further ligation of communicating vessels was necessary. Resection would have been more effective though more difficult. The possibility of post-operative wound infection and secondary infection is sometimes forgotten, though penicillin no doubt will minimize this in the future.

More information is obtainable from reports of larger series of cases in the literature. As to the relative frequency of arterio-venous fistulæ in these aneurysms, Pemberton and Black,[1] from the Mayo Clinic, discuss 67 cases of "acquired" aneurysms, of which 27 were arterial only and 40 were arterio-venous. Of the purely traumatic aneurysms, 12 were arterial and 32 arterio-venous. Haberer[2] in 1939 wrote of 251 personal cases of traumatic aneurysms, in all of which operation was performed. No mention is made in the abstract I have seen of the number of arterio-venous cases. Haberer practised a form of endoaneurysmorrhaphy in preference to ligation in order to conserve the collateral circulation. He states that amputation was necessary in three cases only out of 237 (14 of the series, though, were carotid aneurysms). One aneurysm recurred. Harbison[3] reports 30 battle casualties in which the ratio of aneurysm to arterio-venous aneurysm was two to one (the opposite of the Mayo figures). Reid and McGuire[4] discuss 30 cases of arterio-venous aneurysm. Only 10, that is, one-third, of these cases showed Branham's bradycardiac phenomenon when the fistula was closed. There were varying degrees of cardiac decompensation. In five cases increase in size and length of the limb was present and five patients had

impaired circulation peripheral to the fistula. Two instances were given of arteriovenous fistula which healed spontaneously. The physiological changes consequent on an arterio-venous shunt are well discussed in this paper and also in one by Holman.[5] Many forms of treatment were advocated in the literature, each one no doubt suitable for certain cases. Some form of endoaneurysmorrhaphy would no doubt be the ideal if the sac was accessible, but for most cases ligation above and below the artery (and vein, if involved) with excision of the sac as advised by Romanis[6] seems to be the most satisfactory. Quadruple ligation is not quite as good.

The management of a limb in which the main vessels have been ligated is of some importance. Frequently no special treatment is required, but in those cases in which there is a precarious collateral circulation care must be taken to make the best possible use of the remaining blood flow. Vasospasm can be obviated by a pre-operative or post-operative sympathectomy, and thrombotic occlusions are said to be minimized by the use of heparin or dicoumarol. The metabolic requirements of the limb may be reduced by lowering its temperature (by electric fan or even icepacks), and a slightly dependent position should keep a greater volume of blood in the capillaries. This contrasts strongly with the previous custom of slinging the leg below an electric light cradle.

The dangers of proximal arterial ligature in these cases of traumatic aneurysms are stressed by several authors. Gangrene is apparently more likely to occur. In conclusion it may be interesting to note that it was Ambroise Paré himself who in 1582 first described the bruit over a traumatic aneurysm.[7]

Summary.

1. Four cases of traumatic aneurysm are reported, two of them showing arteriovenous fistulæ.

2. Quadruple ligation was insufficient in one case. The aim should be to excise the sac.

3. The possibility of post-operative hæmorrhage should be remembered.

4. Brief reference is made to recent literature.

Acknowledgement.

Permission to publish has very kindly been granted by the Director-General of Medical Services, Australian Military Forces.

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[2] H. von Haberer: "*Über Behandlung der traumatisch entstandenen Aneurysmen*", *Der Chirurg*, Volume xi, April 15, 1939, page 270.

[3] S. P. Harbison: "Experiences with Aneurysms in an Overseas General Hospital", *Surgery, Gynecology and Obstetrics*, Volume lxxxi, August, 1945, page 128.

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[6] W. H. C. Romanis: "Surgical Treatment of Aneurysms", *The Lancet*, Volume ii, December 7, 1935, page 1275.

[7] Quoted from G. H. Pratt: "Surgical Treatment of Peripheral Aneurysm", *Surgery, Gynecology and Obstetrics*, Volume lxxv, July, 1942, page 103.

Surgery in Other Countries.

[In this column will be published short résumés of articles likely to be of practical value from Journals published in other countries and not readily accessible to surgeons in Australia and New Zealand.]

THROMBOSIS OF THE AORTIC BIFURCATION.

R. Leriche: "*De l'oblitération du carrefour aortique*", *Lyon chirurgical*, January-February, 1946.

THE paper is devoted to a description of that condition which consists of a gradual obliteration of the bifurcation of the aorta, of slow and insidious onset—a condition which is much neglected in the literature. There are two types. In one the thrombosis occurs primarily in one of the common iliac arteries and progresses slowly upwards, ending finally in suppression of the circulation in both iliac arteries and the lower part of the aorta. In the other the primary seat of the thrombosis is in the aorta and progresses downwards. In both types, however, once thrombosis has occurred, obliteration of the lumen is for all practical purposes complete and final, for what small amount of blood can find its way through any later possible "recanalization" cannot avert the onset of gangrene. The arteries in this condition are generally, though not always, enveloped in dense, indurated, periarterial tissue, which also includes the fourth lumbar ganglion. It is also usual to find the vessels heavily atheromatous. The disease may start before the age of thirty years, but is most usual in patients between forty-five and sixty years of age.

On clinical examination one cardinal rule must be borne in mind, namely, that a diagnosis of polyneuritis affecting the lower limbs should never be made without establishing the presence of a femoral pulse. Once this is remembered, the diagnosis is not difficult. The patients usually present themselves complaining of one or more of the following symptoms: impotence, a persistent and total inability to achieve a stable erection; extreme fatigability of the lower limbs, not similar to intermittent claudication, but noticeable even on standing. Nearly always there is generalized atrophy of the lower limbs, which is relatively more difficult to detect than unilateral atrophy, and therefore must be expected and looked for if it is not to be missed. There are no trophic changes in the skin, nails or toes, and considering the relatively normal appearance of these, one is surprised to find the circulation so gravely compromised. The colour of the legs and feet is pale, even when the patient is standing, and ivory white when the limb is raised. No pulse is felt in the popliteal or femoral arteries nor in the iliacs; and the aortic pulse is detected only high up above the umbilicus. This clinical observation may be confirmed by oscillometry. The arterial tension in the upper limbs is slightly raised. When such symptoms are present no operation of any sort whatever should be attempted on the lower limbs, for the wound will heal, if at all, only slowly and with great difficulty. The syndrome is definite and achieves its full effect once it has led one to make an examination of the state of the circulation. The diagnosis is clinched finally by aortography. Such a train of symptoms may persist for five or even ten years before any gangrene occurs. The degree of muscular atrophy increases, walking becomes more and more difficult, a violaceous discoloration of the limb appears, with some ecchymoses, general œdema and pressure sores over any bony points, from the iliac crests to the ankles. And finally a dry gangrene supervenes, occurring in plaques scattered about the limbs, about the leg, in the trochanteric regions, at the edges of the feet, at about the same time as it may be seen in one or more toes. Such patchy gangrene is very typical of this particular condition.

As to treatment, the ideal of resection of the affected vessel and reconstruction by means of vitallium or other artificial vessels is not possible owing to the involvement of the two common iliac arteries. A lesser objective must therefore be aimed at, and Leriche performs bilateral ganglionectomy in the hope of removing vasoconstrictive innervation from possible collateral channels. In addition, resection of the diseased section of the arterial trunks is performed in many cases. Leriche prefers to attack the upper part of the lumbar chain rather than the lower: to remove the first and second ganglia rather than the lower ganglia. His reasoning is that the higher incision avoids any interference with blood channels which might be useful as a collateral circulatory path; and also it appears reasonable to him to attack the nerve supply to the lumbar vessels themselves as high up as is possible. The results so far have been

encouraging. None the less, the higher approach has the disadvantage that it does not permit of examination of the aortic bifurcation nor resection of its damaged portion. This should be done if it is possible, but often it is not possible owing to periarterial induration, in which case one should refrain from a resection which might well destroy the patient. The number of stages in which the sympathectomy and aortectomy should be done depends on the judgement of the surgeon in each individual case.

Leriche concludes: "It is a new chapter in therapy which is opened. It is, I believe, one full of promise."

ARTHUR E. BROWN.

Reviews.

Hospital Care of the Surgical Patient. By GEORGE CRILE, JUNIOR, and FRANKLIN L. SHIVELY, JUNIOR; Second Edition; 1946. Springfield, Illinois: Charles C. Thomas. 8¼″ × 5¼″, pp. 305, with 25 figures. Price: $3.50.

FOR purpose of review this volume was circulated among a small group of house surgeons in one of our clinical schools; the verdict was unanimously favourable. The book aims at providing young surgeons (at the Cleveland Clinic Hospital) with a codification of standard techniques and established principles of pre-operative and post-operative care. A large section deals with physiological conditions related to the care of the surgical patient, namely, water balance, chloride balance, use of glucose and saline solution, acidosis and alkalosis, serum proteins, healing of wounds *et cetera*.

In emphasizing the significance of applied physiology to modern surgery, Evarts A. Graham makes fitting reference in the foreword to the distinguished contributions of George Crile, senior.

Other sections of the work deal in a simple, practical manner with management of surgical complications, pre-operative preparation, post-operative care and common hospital procedures. The authors' creed is always to use the simplest and safest therapy, the most physiological means of accomplishing whatever is necessary.

Included in the book is a novel section on the relations of the house officer, which is much to the point. He is advised of situations demanding diligence, tact and discretion in his official dealings with patients, relatives, nurses, administrative and professional chiefs.

In an appendix of 26 pages an excellent essay by Dr. Crile on the treatment of wounds is reprinted (by permission) from Lewis's "Surgery". This closes a useful and fluent little book, the size of which is not the least of its assets.

101 Clinical Demonstrations to Nurses. By HAMILTON BAILEY, F.R.C.S.; Second Edition; 1946. Edinburgh: E. and S. Livingstone. 8¼″ × 5¼″, pp. 136, with 101 illustrations. Price: 10s. 6d.

THE second edition of this little book closely resembles the first, except that there would appear to be more coloured illustrations. As before, it consists of photographs of some of the more common pathological conditions (some of them also appear in Mr. Hamilton Bailey's other books), and with each photograph there is a brief description of the condition. It should be a helpful visual aid to student nurses.

Anatomical Atlas of Orthopædic Operations. By L. S. MICHAELIS, M.D.; 1946. London: William Heinemann Medical Books, Limited. 9¾″ × 7½″, pp. 67, with 72 figures. Price: 25s. net.

"IN this Atlas incisions and approaches have been collected which are widely used in orthopædic operative work. It is my hope that other surgeons will find it helpful to have at hand, a short description and clear pictures of well tried procedures when they are most needed, that is, before and during a less familiar operation." In this opening statement of his foreword the author sets forth the purpose of this atlas. On reading the volume, however, it is far from clear that this expressed object has been attained. For the experienced surgeon, orthopædic or general, this volume can surely have no value, whilst it is hard to imagine the beginner not finding it necessary to turn for guidance to less succinct sources. The descriptions are far too curtailed to have any real value, whilst the illustrations depicting incisions and approaches are too diagrammatic to guide safely and accurately the knife of the tiro.

On page 56 there is a heading "Some Incisions and Approaches to Peripheral Nerves". The attack on the brachial plexus roots above the clavicle is dealt with in three lines which describe merely an incision, whilst the brachial plexus trunk is favoured by having a little more than three lines similarly devoted to the incision.

The operation for sacro-iliac arthrodesis according to the Smith-Petersen technique might be described as being in the less familiar category as far as the general surgeon is concerned. It is difficult to appreciate the amount of help the description of this procedure as set out in this atlas would provide such a surgeon.

The textual description and illustrations covering the highly technical procedure of tendon transplantation for complete radial palsy on page 60 have nothing to recommend them. Any general surgeon attempting the procedure recommended and depending upon text and illustrations to guide him would be heading for serious trouble. Apart from our strong condemnation of the procedures recommended, we find further ground for objection in the failure of the writer to make any mention of the various essential details, the meticulous attention to which is necessary if tendon transplantation is to be successful. Surgeons proposing to carry out this tendon transplantation would be better advised to follow the technique and routine laid down by the late Sir Robert Jones.

The surgeon who proposed to lay bare the long head of the biceps, as described on page 14, would find that even the most persistently wielded blunt dissector, having torn its way through the fibres of the deltoid, would be far from having exposed the tendon as suggested in this volume.

We read with perturbation on page 58 that transplantation of the ulnar nerve, presumably to the front of the elbow, requires that all muscles of the flexor origin on the medial humeral epicondyle, except the humeral head of the *pronator radii teres*, must be detached and that the medial intermuscular septum must be excised.

These are merely a few of the many points which lead us to conclude that the volume falls far short of fulfilling the purpose which its author sets forth. It is very well printed and the diagrams, though their value is questioned, are clear.

Surgical Nursing and After Treatment. By H. C. RUTHERFORD DARLING, M.D., M.S., F.R.C.S.; Ninth Edition; 1946. London: J. and A. Churchill, Limited. 7½″ × 5″, pp. 694, with 211 illustrations.

"SURGICAL NURSING AND AFTER TREATMENT", by H. C. Rutherford Darling, has in its ninth edition, 1946, maintained its high standard attained in previous publications. (The first edition appeared in 1917.)

The work is well set out in chapters, dealing in Section 1 with general surgical nursing, and with regional surgical nursing in Section 2, which is followed by a comprehensive appendix. Each chapter is preceded by a concise summary of its contents, such arrangement being useful as an aid in learning and as a guide in answering examination questions. For others already qualified it forms a handy résumé of much valuable practical and theoretical information.

The book is well illustrated with diagrams and charts. One would, however, like to see the sister prepared for operation (page 137) with "hands up"; undue prominence is also given to some outmoded procedures and appliances—splints such as Cline's, Carr's angular elbow splints, not common now in general use. Likewise, in blood transfusion, the Kimpton tube is seldom seen now, blood being obtained from the blood bank or given directly from the donor's vein (and not the artery) to the recipient's vein by means of one of the many modern and efficient "pumps".

Operative technique, pre-operative and post-operative nursing are well described and illustrated, the after-treatment of the various operations being set out in great detail—information which is of considerable value to the practising nurse.

The book is of handy size, well published, and should be equally valuable to the trainee, those qualified and all interested in the progress and teaching of surgical nursing.

Food and Nutrition: The Physiological Bases of Human Nutrition. By E. W. H. CRUICKSHANK, M.D. (Aberdeen), D.Sc. (London), Ph.D. (Cantab.), M.R.C.P.; 1946. Edinburgh: E. and S. Livingstone, Limited. 8¼″ × 5¼″, pp. 334, with 41 figures. Price: 16s. net.

PROFESSOR CRUICKSHANK, Regius Professor of Physiology in the University of Aberdeen, has published for medical practitioners, medical students and people concerned with public welfare a book which presents recent knowledge of the physiology of food and nutrition and of the problems of feeding the British nation during six years of war.

After an historical introduction on the evolution of food habits, a discussion follows on international food problems, the particular problems of nutrition in the United Kingdom and the way in which these problems have been faced during the war. In Britain the all-important aim was the adequate distribution of those foodstuffs considered essential for the maintenance of bodily health and vigour. This policy has shown that scientific advice freely taken and used will ultimately solve problems of malnutrition.

In the next section is given a brief account of foodstuffs and food components and of deficiency diseases associated with the lack of particular nutrients. It is to be regretted that the reproduction of photographs of patients showing the effects of mineral and vitamin deficiencies is so poor. No reference is made to recent work on the significance to human beings of carotene, or of the members of the vitamin *B* complex other than riboflavin and niacin.

Professor Cruickshank summarizes clearly the scientific data on such controversial subjects as wholemeal or white bread, pasteurization of milk, vegetarianism, the relationship between diet and dental caries, and the use of synthetic vitamins. There is a useful review of the methods for the appraisal of the nutritional state of individuals and communities and of the value of such information. Throughout the book references are given to recent publications, although these are usually limited to investigations undertaken in the United Kingdom. Professor Cruickshank considers that the future peace of the world will depend on the satisfactory solution of the problem of world malnutrition. In the concluding chapter on the Food and Agriculture World Organization he gives a brief summary of the plans envisaged for the relief of the underfed people of the world and the equitable distribution of world food supplies.

"Food and Nutrition" is a thought-provoking and comprehensive survey of the subject. It is to be recommended to all who are concerned with the future welfare of the peoples of the world, for, as Professor Cruickshank states, ". . . food in relation to physical fitness is not only an individual matter, but one affecting the state of health and efficiency of the nation".

The Surgical Technique of Abdominal Operations. By JULIUS L. SPIVACK, M.D., LL.D.; Fourth Edition: 1946. Springfield, Illinois: CHARLES C. THOMAS. 9¾″ × 6¼″, pp. 726, with 362 figures. Price: $10.00.

THE revised edition of this standard textbook follows much the same lines as the previous one, but a little more is included in the descriptions of aseptic methods of anastomosis, by the method of Parker-Kerr, and aseptic anastomosis with the Rankin clamp—a method which is very popular at present in America.

This book is well produced and adequately illustrated with simple drawings, and each chapter carries a full bibliography. However, it is a compendium of operations rather than a selection of the best, and little critical discussion of the various methods is included.

Textbook of Medical Treatment. Edited by D. M. DUNLOP, L. S. P. DAVIDSON and J. W. MCNEE, D.S.O.; Fourth Edition; 1946. Edinburgh: E. and S. Livingstone, Limited. 9¼″ × 6¼″, pp. 942, with 38 figures. Price: 30s. net.

THE fourth edition of this well-known and deservedly popular work is well up to the standard of its predecessors. It is an extremely difficult task to compile a textbook of modern treatment which is useful for students and graduates, but the authors have performed the task admirably and have been able to include most of the recent advances in therapeutics.

To avoid unnecessary repetition, there are separate sections for sulphonamide and penicillin therapy, which cover the subjects adequately. Of necessity the latter section cannot have the most recent refinements, but the principles involved are clearly stated. The section on pulmonary tuberculosis is most thorough and gives a clear picture of what methods of treatment are available in this disease. Thiouracil in the treatment of thyreotoxicosis is discussed lucidly with a very clear summing up of the evidence in its favour. Apparently the most recent derivatives had not appeared when this edition was written. The treatment of the other endocrine disorders is also adequately described, including a comparatively short list of female sex hormones (that is, their commercial preparations), which will prove of value to those practitioners who have not had the opportunity to follow the bewildering "progress" of these products. There is an excellent section dealing with diabetes and diabetic coma, and particular stress is laid on adequate dosage of insulin in the latter. This chapter should provide encouragement to those practitioners who doubt their ability to treat even the mildest diabetic.

It seems that some of the lessons of war medicine have not been carried over to peace, and it is a pity that more definite and prolonged courses of treatment were not recommended for amœbic dysentery and malaria, especially as these diseases are likely to occur in civil practice for a few years still. The use of a "booster" dose of tetanus toxoid after injury in a previously inoculated subject is not mentioned. One final criticism is of the statement that laparotomy and drainage of the common bile duct in hepatitis is sometimes of therapeutic value. Perhaps there is a different type of hepatitis occurring here, but experience of these cases has shown this procedure to be fraught with the gravest danger and to be often fatal. However, considering the difficulties facing the authors, it is to their lasting credit to have produced a volume which will be of the greatest value to all practitioners and students.

Anesthesia in General Practice. By S. C. CULLEN, M.D.; 1946. Chicago: The Year Book Publishers, Incorporated. 8″ × 5¼″, pp. 260, with 36 figures. Price: 28s.

THE title of this book may be somewhat misleading, as it rather indicates that it concerns anæsthesia for the general practitioner, when in fact it applies to methods used in general anæsthetic practice. This book is good. It is written by the head of the division of anæsthesiology, State University of Iowa Hospital, and the reader gets the impression that it is based on the author's practical experience rather than on purely theoretical considerations.

As the author states in his preface, the book is not to be construed as a "complete text in anæsthesiology", but rather as a manual useful to the student and anæsthetist.

The book opens with a chapter on pre-anæsthetic medication and covers the whole range of anæsthetic agents and techniques in current practice today, including controlled respiration and use of curare. The final chapters are devoted to shock, oxygen therapy, and the pre-anæsthetic and post-anæsthetic care of the patient. It is of interest to see a whole chapter devoted to the establishment and maintenance of a perfect airway. There is no other single factor so essential as this in the conduct of safe and satisfactory anæsthesia, and this is not always sufficiently stressed to the student.

There is no waste material in this book, which is an extremely useful manual for those interested in anæsthetic practice.